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EPA Analysis of the Amendment to Delete 'Engine Brake' Deceleration Testing from the Medium and Heavy Truck Noise Regulation

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A presentation of the questions posed and an assessment of the issues related to the consideration of the amendment to delete deceleration testing from the medium and heavy truck noise regulation (40 CFR 205) is reported. Although noise emissions from engine brake operation are unique in character, it appears that noise control using engine exhaust muffling for the vehicle acceleration mode also reduces engine brake deceleration sound levels. Economic impacts of vehicle deceleration testing using engine brakes appear minimal if engine brakes are installed at the point of manufacture.

The report contains EPA Regulatory Docket No. ONAC 77-3 exhibiting all comments submitted by interested parties.

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U.S. ENVIRONMENTAL PROTECTION AGENCY
Washington, D.C. 20460

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INTRODUCTION

This report presents the issues and an assessment of the issues of the amendment to 40 CFR Part 205 (Transportation Equipment Noise Emission Controls, Medium and Heavy Trucks) striking 40 CFR § 205.54-1(c)(1)(iv) and 205.54-1(c)(2)(iv). The amendment deletes the requirement for conducting noise emission tests using a deceleration test mode for medium and heavy trucks equipped with engine brakes.

The Agency's analysis of the amendment is based upon currently available information (1)* related to noise emissions from engine brake operation and associated economic and health and welfare impacts of the proposed amendment.

Engine brakes are one type of engine retarder system. They are typically installed on heavy diesel-powered trucks and provide an alternate braking system that is used for going down long, steep grades in mountainous areas. The most cited advantages of engine brakes are that they save wear and tear on the regular braking system and that they are a safety factor in that an alternate braking system is available should the regular braking system fail.

Appendix A of this report presents the notice of the amendment and comments submitted to Docket No. ONAC 77-3 during the public comment period. Appendix B presents a letter submitted to EPA/ONAC prior to the public comment period and Appendix C presents graphic interpretations of sound level recordings of engine brake noise emissions.

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* Numbers in ( ) denote references listed at the end of this report.

THE ISSUES

The major issue with respect to the decision to delete or include deceleration noise emission testing for medium and heavy trucks equipped with engine brakes is:

> Will vehicles equipped with engine brakes, if tested in the deceleration mode, as required by the existing regulation, exceed the noise emission standards applicable to vehicles tested in the acceleration mode? If so, by how much, why, and under what conditions?

Ancillary issues also addressed are:

(a) Noise Control Technology: Can the noise resulting from engine brake operation be controlled effectively?

(b) Health/Welfare Impacts: What effect do the noise emissions from engine brake operation have on the health/welfare impact assessment for medium and heavy trucks?

(c) Noise Emissions from Engine Retarders: Should engine brakes be identified explicitly or should deceleration testing be required for all engine compression decelerating devices?

(d) Economic Impact: Will deceleration testing have a severe economic impact on manufacturers of engine brakes? Are there substitutes for engine brakes that will have a market advantage if deceleration testing is required?

(e) Safety Considerations: Will engine brakes not be used where, for safety reasons, they should be used?

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ASSESSMENT OF THE ISSUES

The Major Issue

For a medium or heavy diesel-engine truck, the A-weighted sound level reported under SAEJ366b testing specifications appears to be lower for deceleration tests than acceleration tests if the vehicle is equipped with mufflers. For vehicles operating without mufflers or with worn mufflers, the A-weighted sound level reported under SAEJ366b testing appears to be significantly higher for the deceleration mode than for the acceleration mode. In either case (i.e., muffled or unmuffled diesel engine trucks), the almost pure tone low frequency "popping" noise generated by the operation of an engine brake results in a characteristic noise spectrum uniquely associated with engine brake operations.

To evaluate the relative magnitudes of sound levels emitted by medium and heavy trucks equipped with Jacobs engine brakes, published test data (2) was reviewed and analyzed. Figure 1 presents a plot of dBA sound levels for vehicle acceleration mode (vertical axis) versus dBA sound levels for vehicle deceleration mode (horizontal axis). These data indicate that unmuffled engines emit higher deceleration sound levels than acceleration sound levels. The data also indicate that vehicles equipped with mufflers generally exhibit lower deceleration sound levels than acceleration sound levels.

The Agency conducted SAEJ366b vehicle noise emission tests under the bus noise regulatory development program. One bus model with standard transmission (two vehicles) was tested both for acceleration and for deceleration. During the deceleration tests, the vehicles were operated using Jacobs engine brakes. These data are presented in Figure 2. The

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acceleration sound level is the vertical axis and the deceleration sound level is the horizontal axis. The deceleration sound levels are from 1 to 5 dBA higher than the acceleration sound levels.

Additionally, the EPA Region VIII office conducted field demonstration noise emission tests on an unmuffled Kenworth truck equipped with a Jacobs engine brake (3). This demonstration and the resulting data were not taken under SAEJ366b test conditions but are considered to be typical of field conditions. Measurement distances were 50 feet for deceleration tests and 62 feet for acceleration tests.

Figures 3 through 7 present level recorder output (sound level versus time) for the five vehicle pass-by noise tests conducted for this demonstration. Three-level recordings are presented for each event. The top level recording for each event presents the linear (no frequency weighting) sound level versus time. The middle level recording presents the C-weighted sound level versus time. The lower level recording presents the A-weighted sound level versus time. These level recordings are presented to illustrate the quite significant level-duration differences between sound levels using frequency weighting for engine brake noise emissions. All the level recordings indicate peak level differences between dBC and dBA values of approximately 5 to 8 dB (dBC levels higher). Of more importance however, is the duration of higher dBC levels over the entire record (typically 10 dB). The dBC levels — it is believed — represent more closely the characteristic "popping" sounds of the engine brake operation than the dBA levels. (The complete voice transcription and data for the vehicle pass-by events contained on the demonstration tape recording are presented in Appendix C to this report.)

(a) Noise Control Technology

It appears that — based upon available test data — the deceleration sound levels resulting from engine brake operation can be significantly decreased using existing muffler technology (2). For comparison, typical vehicle acceleration sound levels for unmuffled vehicles appear to be 93 to 95 dBA while for muffled vehicles the levels appear to be around 85 dBA (see Figure 1). For engine brake operation during truck deceleration conditions, unmuffled vehicles exhibited average sound levels of 101.5 dBA and muffled vehicles exhibited average sound levels of 84 dBA.

The vehicles cited above are diesel-engine heavy trucks tested under SAEJ366b conditions (2, p. 28). This data does not indicate whether the characteristic low frequency "popping" resulting from the operation of an engine brake is significantly altered. Test data (4, p. 8) and commentary (4, p. 8), (5) indicate that muffling engine exhaust noise for an acceleration test mode may not necessarily result in optimum exhaust noise muffling for the deceleration mode using engine brakes.

In the petition of Jacobs Manufacturing Company (6, p.16 and Exhibit D) to the Agency for reconsideration of medium and heavy truck noise emission regulations, additional sound level data were reported. The data reported are presented in Table I and indicate that vehicle noise emission levels can be reduced below 80 dBA for both the acceleration test mode and the deceleration test using an engine brake if the vehicle is equipped with appropriate mufflers (see Table I).

(b) Health/Welfare Impact

Analysis of the health/welfare impact assessment for medium and heavy duty trucks, including noise generated by operation of engine brakes, considered the following:

(i) The existing data available to the Agency indicate that sound levels resulting from vehicle deceleration using engine brakes are not significantly different from vehicle acceleration levels if the vehicles are equipped with proper mufflers (under the existing applicable EPA test procedures).

(ii) The percentage of vehicles in the 1972 national fleet equipped with engine brakes was relatively small, approximately 2 percent (less than 75,000 trucks) of the national fleet (6, p. 17). Engine brake usage is quoted as 3 to 5 percent of vehicle engine hours with the engine brake activated every 3 to 8 miles of vehicle movement (6, Exhibit F).

In 1974, it was indicated (2, p. 1 and 4, P. 1) that 120,000 to 140,000 Jacobs engine brakes were operational in the U. S. Additionally, Jacobs Manufacturing Company indicated that in 1974, 25 percent of the heavy trucks on the west coast of the U. S. were equipped with engine brakes (5, see Appendix B). It appears, therefore, that between 1972 and 1974 the number or trucks equipped with engine brakes either increased by 60 percent or the engine brakes were distributed to vehicle types other than medium and heavy trucks.

Consequently, for a health and welfare assessment on a national basis, the impacts due to engine brake operation are very small due to the relatively small number of trucks equipped with engine brakes. However, in those areas where engine brakes are heavily concentrated, the health and welfare impacts could be significant.

(iii) The distribution of land use and hence population densities associated with engine brake operation is difficult to assess, based upon existing data.

(iv) An Leq descriptor based upon the A-weighted sound level is not necessarily appropriate to assess the low frequency "popping" sound characteristic of engine brake operation in order to evaluate potential adverse health/welfare impacts, especially if averaged over a daily or an annual basis. A more appropriate descriptor is conceivably an Leq value based upon the C-weighted sound level. The Agency is presently evaluating the appropriateness of other than the A-weighted sound level for use in assessing potential health/welfare effects, with respect to certain noise sources. The noise emitted by engine brakes will be further evaluated in this regard.

(v) Additionally, it is perhaps appropriate to consider a single event noise impact analysis to evaluate effects from engine brake operation in relation to determining potential health/welfare benefits.

(vi) The noise from engine brake operation is, subjectively, unique in character and readily identifies the source as a "Jake Brake." The empirical assessment as to how much, if any, additional human annoyance or activity disruption results from this noise, as opposed to the overall noise from the truck, is not known at this time.

(c) Noise Emissions from Engine Retarders

Engineering sound level data associated with engine retarders other than engine brakes is not currently available. Therefore, it was not possible to compare sound levels of engine brakes with other engine retarders such as exhaust brakes or other engine compression devices that are similar to engine brakes.

(d) Economic Impact

The costs associated with all noise abatement testing for medium and heavy trucks (deceleration testing included) are minimal. The costs range from $0.38 to $0.57 per vehicle (7, p. A-5-14).

If engine brakes are installed after the vehicle has been assembled by the manufacturer and delivered to a dealer or distributor, the potential requisite testing could result in the imposition of more substantial costs. The person or organization responsible for testing would then be different than for other normal noise testing of trucks. This factor could discourage persons in organizations other than the manufacturer from installing engine brakes.

The demand for engine brakes appears to be relatively inelastic. Demand for engine brakes is based on reduced operating costs and safety features (2, p. 26-17; 8). It appears that between 1972 and 1974 the number of vehicles equipped with engine brakes increased significantly (see (b) above). It is unclear as to whether there exists a substantially expanding market for engine brakes. Data indicate (2, p. 26-27) that the engine brake can pay its cost — compared to brake relining costs — at the 105,000 mile operation point (1974 data). Based upon an average annual mileage of 54,000 miles for a heavy diesel truck, the engine brake could pay for itself in approximately 2 years. Thus, the use of engine brakes for other than exclusively safety reasons is apparent.

The Agency is aware of other engine retarding systems that may potentially substitute for engine brakes. These systems comprise exhaust brakes and electromagnetic retarders (attached to the vehicle drive train). Data are not presently available, however, to quantify both the safety features and economic advantages of potential substitutes for engine brakes. If no comparable braking systems are available, the demand for engine brakes should remain essentially unchanged. If the same mufflers are used for trucks with or

without engine brakes, no price increase is expected due to the regulatory requirement of a deceleration test for engine brake noise emissions.

(e) Safety Considerations

Based on their highly desirable economic and safety appeal, it appears likely that truck owners would continue to purchase engine brakes if deceleration noise testing was required. However, the fact that very large numbers of trucks operating frequently in mountainous terrain are not so equipped indicates that the safety-related value and cost-effectiveness of engine brakes are not favorably viewed by large numbers of the truck purchasing community.

SUMMARY

Although the distinct "popping" noise characteristics associated with engine brake operation can be an annoying sound of intermittent nature, the data available indicate that significant noise reduction is achieved for both acceleration and deceleration vehicle modes if trucks with engine brakes are properly muffled.

Currently available data indicate that exhaust system muffling is an adequate noise control measure for deceleration noise from trucks equipped with engine brakes. Deceleration noise levels (with engine brake), in general, are lower than acceleration noise levels on the same truck when muffled. In addition, it should be noted that the sound level standards imposed by the Medium and Heavy Truck Noise Regulation (40 CFR 205) cannot be met without the installation of advanced mufflers that are more effective than those presently available. The Agency is committed to vehicle noise reduction and, as such, will continue to monitor regularly the noise generated by engine retarders installed on all types of vehicles. To this end, in the future, the Agency plans to conduct deceleration testing on newly manufactured trucks equipped with engine brakes.

Noise emissions from engine brake operation are unique and characteristic in nature. Likewise, a health/welfare impact assessment of engine brake noise must be unique to this source. At this time, it is not evident that such a unique assessment would result in significant differences when compared to the health/welfare analysis conducted for medium and heavy trucks.

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Economic impacts of deceleration noise emission testing are minimal if the primary manufacturer of the vehicle installs the engine brake and there are no substitute systems available.

REFERENCE: Greig, J.C., "The Jacobs Engine Brake", Institute of Mechanical Engineers, paper C5/74, Conference Publication 1 1974 (England)

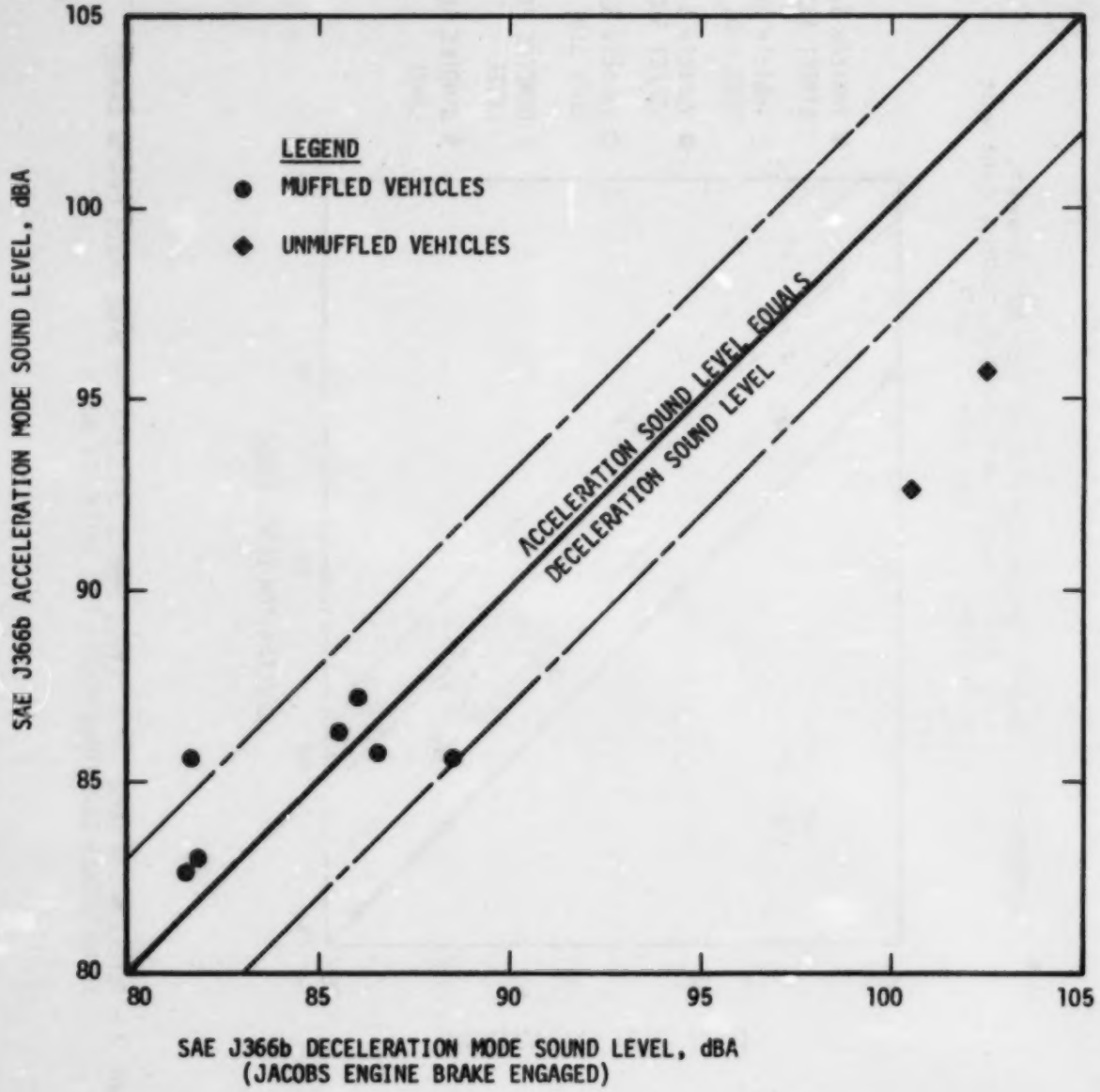

Figure 1 - ACCELERATION MODE SOUND LEVELS VERSUS DECELERATION MODE (WITH ENGINE BRAKE) SOUND LEVELS (SAEJ366b TESTS) FOR HEAVY TRUCKS

REFERENCE: Anon; "Noise Levels of New MCI Buses", Booz-Allen Applied Research, USEPA Contract 68-01-3509 October 7, 1976

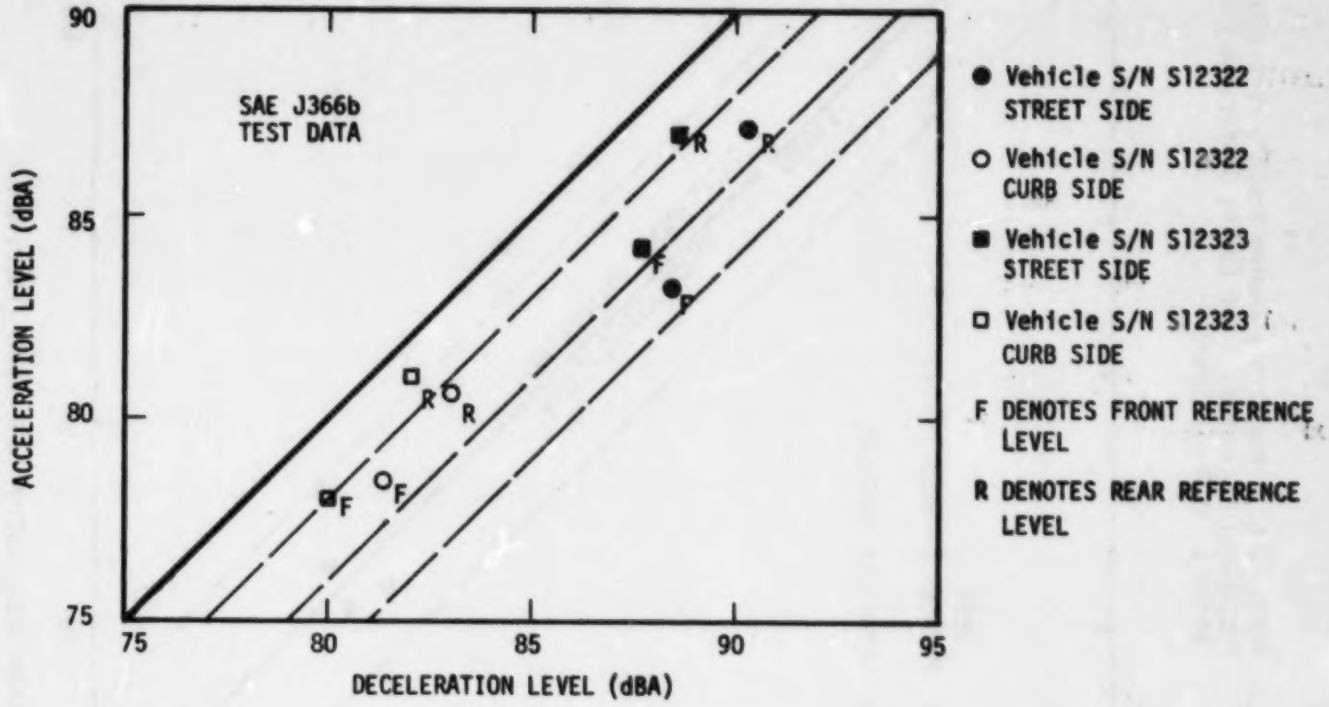

Figure 2 - ACCELERATION MODE SOUND LEVELS VERSUS DECELERATION MODE (WITH ENGINE BRAKE) SOUND LEVELS (SAEJ366b TESTS) FOR INTERCITY BUSES

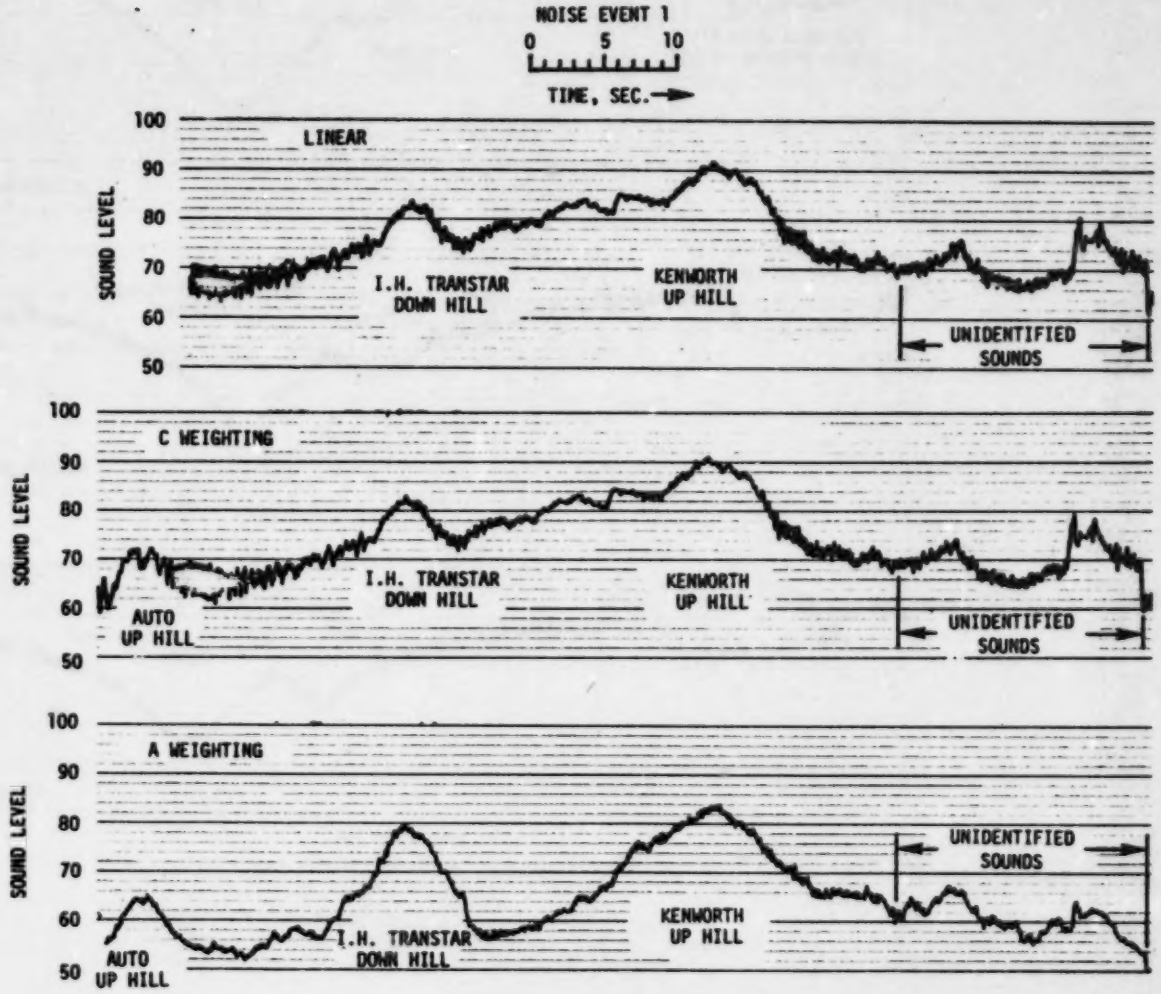

Figure 3 - LEVEL RECORDINGS OF VEHICLE PASS-BY NOISE: NOISE EVENT 1 (Reference 3)

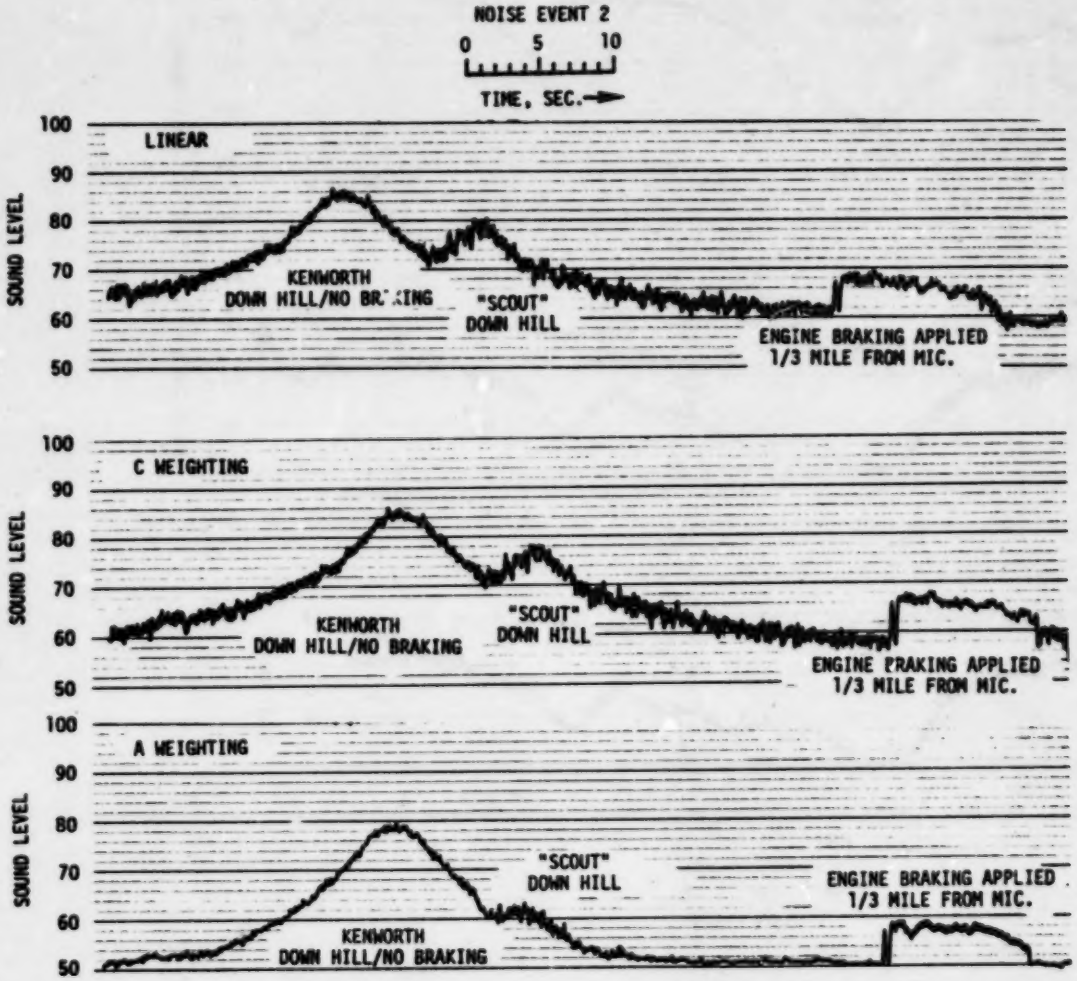

Figure 4 - LEVEL RECORDINGS OF VEHICLE PASS-BY NOISE: NOISE EVENT 2
(Reference 3)

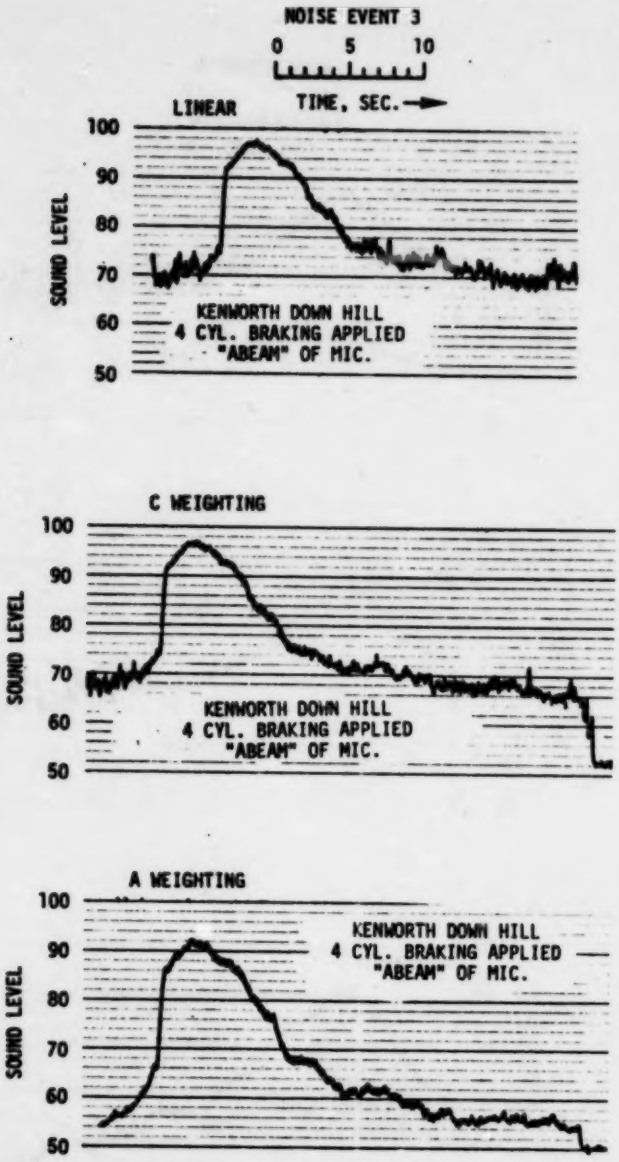

Figure 5 - LEVEL RECORDINGS OF VEHICLE PASS-BY NOISE: NOISE EVENT 3 (Reference 3)

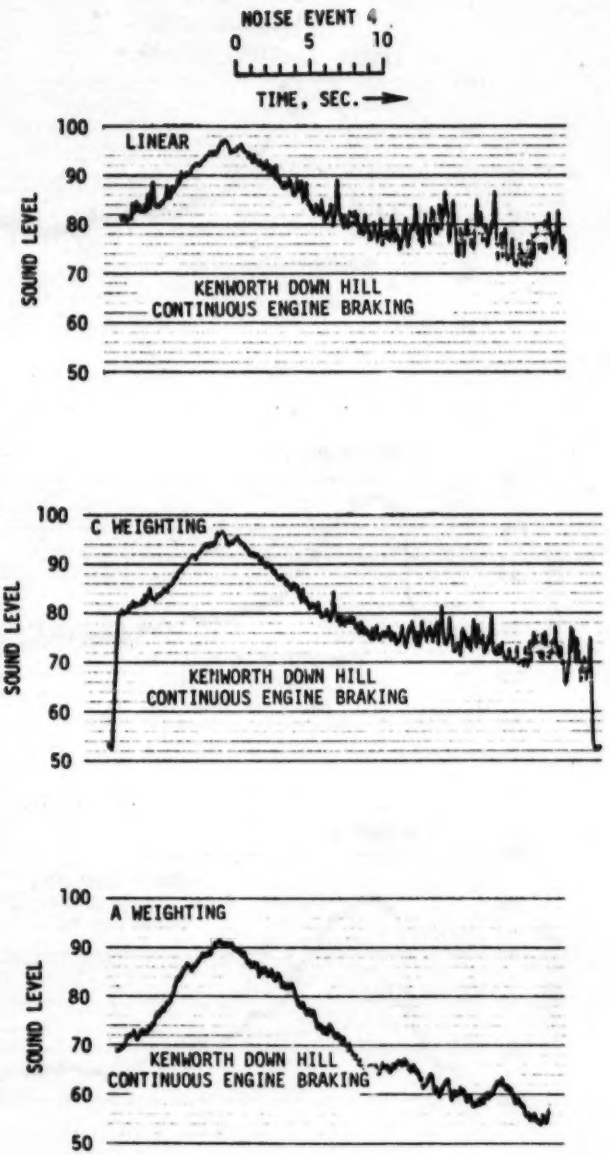

Figure 6 - LEVEL RECORDINGS OF VEHICLE PASS-BY NOISE: NOISE EVENT 4 (Reference 3)

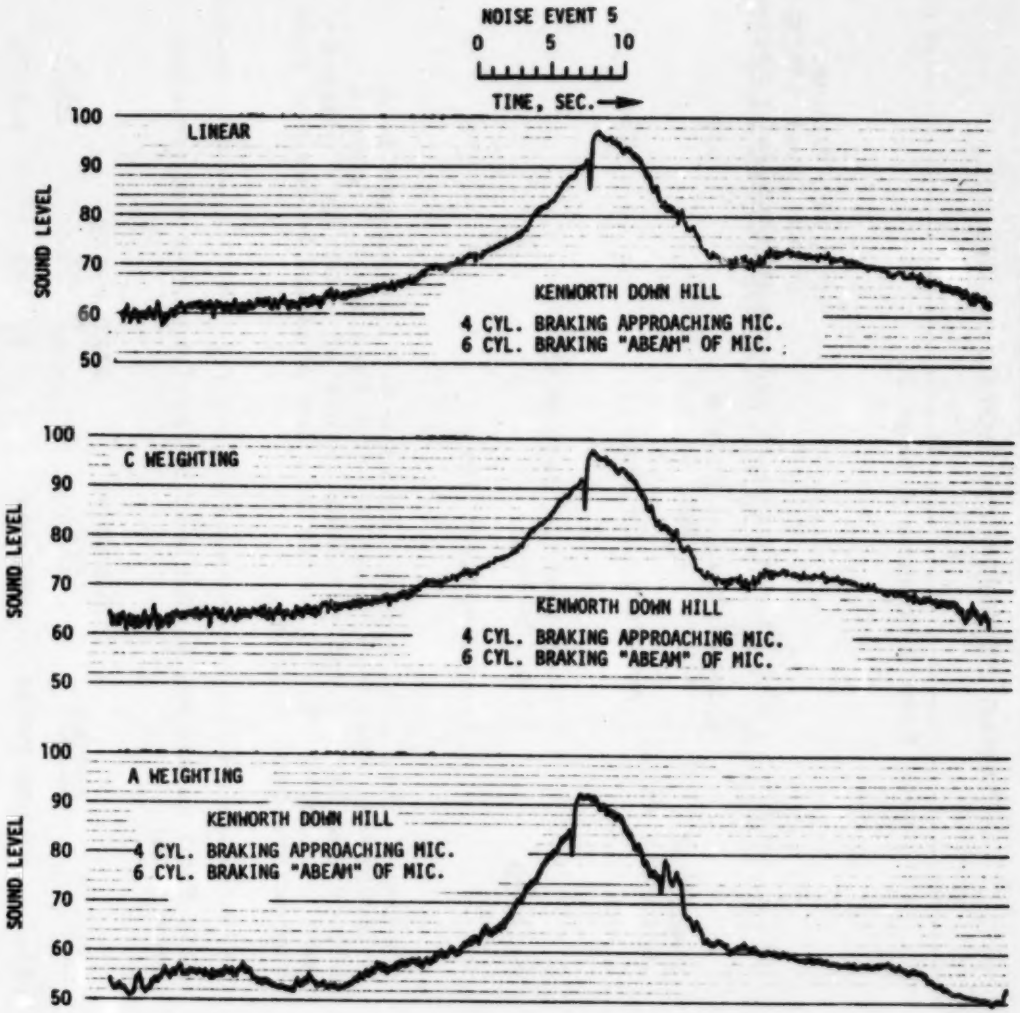

Figure 7 - LEVEL RECORDINGS OF VEHICLE PASS-BY NOISE: NOISE EVENT 5 (Reference 3)

TABLE I

SOUND LEVEL DATA FOR ENGINE BRAKES

(TESTING PROCEDURE NOT EXPLICITLY STATED)

Data from Reference 6 page 16

		Overall Exhaust Noise Level (dB(A)) (Approximate Values)
Unmuffled (Straight Pipe)	Deceleration Test with Engine Brake	102
	Acceleration Test	95
Muffled	Deceleration Test with Engine Brake	76
	Acceleration Test	78

Comment: This data appears to have been extracted from Reference 4, Figure 3, page 8. The data in Reference 4 are octave band sound pressure levels at a 50-foot measurement distance. The above values are presumably derived from the octave band spectra.

Data From Reference 6, Exhibit D (Freightliner Corporation test data)

S/N	ENGINE	DRIVE-BY LEVEL	JAKE BRAKE LEVEL	DATE
112526	DDE 8V92T	84 dBA	80 dBA	8-4-75
114602	NTC 290	83 dBA	77 dBA	8-6-75
114241	DDE 8V71T	82 dBA	79 dBA	8-7-75

REFERENCES

1. Rudder, F.F., and Colonna, C.; "Analysis of the Proposed Amendment to Delete Deceleration Testing from the Medium and Heavy Truck Noise Regulation," Report to U.S. Environmental Protection Agency, Office of Noise Abatement and Control, May 18, 1977.

2. Greig, J.C.; "The Jacobs Engine Brake," Institute of Mechanical Engineers, Conference Publication 1, Paper C5/74, 1974.

3. Bryant, William; "Demonstration Tape Recording of Engine Brake Operational Noise of an Unmuffled Kenworth Truck," Recorded by Region VIII, U.S.E.P.A. personnel, Boulder, Colorado, April 13, 1977 (See Appendix C)

4. Morse, W.H.; "The Jacobs Engine Brake ("Jake Brake") Reviewed," Presented to Technical Session on Engine Retarders, SAE Automotive Engineering Congress and Exposition, Cobo Hall, Detroit, Michigan, February 25, 1975.

5. Letter from Mr. R.B. Price, Project Engineer, Jacobs Manufacturing Company to Dr. Alvin F. Meyer, Deputy Assistant Administrator, Office of Noise Abatement and Control, Environmental Protection Agency: Dated July 25, 1974 (See Appendix B)

6. Kintner, E.W., et. al.; "Petition of Jacobs Manufacturing Company for Reconsideration of Medium and Heavy Truck Noise Emission Regulations," Submitted to the Administrator, Environmental Protection Agency, June 4, 1976; Arent, Fox, Kintner, Plotkin & Kahn, 1815 H Street, N. W., Washington, D. C., Counsel for Petitioner.

7. Anon.; "Background Document for Medium and Heavy Truck Noise Emission Regulations," U.S. Environmental Protection Agency Report EPA-550/9-76-008, Washington, D.C., March 1976.

8. Weaver, L.S.; "Product Improvement Test of Brake System for Trucks, 5-Ton, 6x6, XM809) Series"; Report No. APG-MT-3813; U.S. Army Tank Automotive Command, Aberdeen Proving Ground, Maryland, April 1971.

APPENDIX A

DOCKET NO. ONAC 77-3

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3-15-77	77-3-002	Mack Trucks, Inc. P.O. Box 1761 Allentown, Pa. 18105 John H. Humpton, Jr. Executive Engineer - Vehicle Regulations and Standards	A-9
3-15-77	77-3-003	American Trucking Associations, Inc. 1616 P Street, N.W. Washington, D. C. 20036 William J. K. Gibson Automotive Engineer	A-11
3-15-77	77-3-004	Department of California Highway Patrol P. O. Box 898 Sacramento, California 95804 G. B. Craig Commissioner	A-13
3-22-77	77-3-005	Freightliner Corporation 4747 N. Channel Avenue P. O. Box 384-9 Portland, Oregon 97208 Roger W. Sackett	A-15
3-22-77	77-3-006	Environmental Protection Agency Region VIII 1860 Lincoln Denver, Colorado 80295 Robert A. Simmons, Supervisor Noise Control Program (8 AH-WM)	A-17

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4-20-77	77-3-008	Montgomery County, Maryland Room 340 6110 Executive Boulevard Rockville, Maryland 20852 Richard J. Peppin County Acoustical Engineer	A-23
4-26-77	77-3-009	International Harvester P. O. Box 1109 Fort Wayne, Indiana 46801 N. A. Miller, Staff Engineer Sound & Energy	A-25
4-26-77	77-3-010	Kern Valley Trucking 3901 Medford Street Los Angeles, California 90063 J. L. Chase, President	A-27
5-3-77	77-3-011	U. S. Department of the Interior Office of the Secretary Washington, D. C. 20240 Heather L. Ross Deputy Assistant Secretary of the Interior (Acting)	A-29
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APPENDIX A

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4-18-77	77-3-014	Freightliner Corporation P. O. Box 3849 Portland, Oregon 97208 Roger W. Sackett	A-37
3-10-77	77-3-015	Department of Noise Control California State Department of Health 2151 Berkeley Way Berkeley, California 94704 A. E. Lowe	A-39

Title 40—Protection of Environment

CHAPTER 1—ENVIRONMENTAL PROTECTION AGENCY

[FRL 684-6]

PART 205—TRANSPORTATION EQUIPMENT NOISE EMISSION CONTROLS

Medium and Heavy Trucks

This notice amends 40 CFR Part 205 by striking 40 CFR §205.54-1(c)(1)(iv) and 205.54-1(c)(2)(iv). The amendment, which will take effect May 31, 1977, is made in response to a petition for reconsideration submitted by the Jacobs Manufacturing Company.

In subpart B of 40 CFR Part 205 the Environmental Protection Agency (EPA) established noise emission standards for medium and heavy trucks. (See 41 FR 15538, April 13, 1976.) The test method which accompanies those standards was was developed from a test method used by the truck manufacturing industry, SAE J366b, which included a requirement that all trucks equipped with engine brakes must be subjected to an extra passby test with the engine brake engaged. This requirement was incorporated in the federal noise emission standards, 40 CFR §205.54-1(c)(1)(iv), 205.54-1(c)(2)(iv). On June 4, 1976, the Jacobs Manufacturing Company, manufacturer of engine brakes, petitioned the EPA to delete these provisions on the grounds that the additional test burden would likely induce truck manufacturers to stop offering engine brakes on their products, eliminating the safety and economic benefits attributable to engine brakes, and that there would be little environmental benefit because of the limited use and low noise levels of engine brakes. The petition included additional information which had not been considered during the development of the regulation.

Having studied the information and petition submitted by Jacobs Manufacturing Company, the Administrator has determined that it is appropriate to grant the petition and delete 40 CFR §205.54-1(c)(1)(iv) and 205.54-1(c)(2)(iv). The evidence indicates that at the levels at which EPA has set the noise emission standards, 83 dBA (1978) and 80 dBA (1982), the noise contributed by engine brakes during deceleration is not high enough to be a contributing factor, and therefore the additional passby with the brake engaged adds nothing to the test. This being the case, there is no environmental benefit to offset any additional burden which the requirement may impose.

The Administrator finds no evidence to support the Jacobs Manufacturing Company's assertion that the incremental cost of the additional passby test will cause truck manufacturers to cease offering engine brakes on any of their models. The minimal amount by which this would add to the cost of testing makes such a result unlikely.

As stated on April 13, 1976 (41 FR 15543) the Administrator is considering lowering the standard for a future date beyond 1982. When this occurs, the noise from engine brakes may become a factor, and it will be necessary to consider whether the engine brake passby test should be instituted at that time. Accordingly, the Administrator's conclusions will be reviewed in full at that time based on all information then available.

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Public Comment: This amendment will not take effect for ninety days (May 31, 1977). The Administrator has determined that the public should be given an opportunity to comment on the deletion of 40 CFR S205.54-1(c)(1)(iv) and 205.54-1 (c)(2)(iv). Accordingly, all interested parties are invited to submit comments on this amendment, including specifically the conclusions of the Administrator with respect to economic impacts of the requirement, its environment benefits, and the contribution of engine brakes to truck noise levels during testing according to EPA test procedures. Comments must be received by EPA no later than March 14, 1977.* Unless information is received which merits the withdrawal of this amendment before its effective date, the amendment will take effect without further notice from EPA.

Comments should be submitted, with 5 copies when possible, to: Director, Standards and Regulations Division, Office of Noise Abatement and Control (AW-471), Attention: Docket No. ONAC 77-3, U.S. Environmental Protection Agency, Washington, D.C. 20460.

The Jacobs Manufacturing Company petition and all related information together with copies of all responses received in response to this notice will be available for public inspection at the EPA Public Information Center, Waterside Mall, 4th and M Streets, S.W., Washington, D.C.

(Sec. 6 and 13, Pub. L. 92-574, 86 Stat. 1234 et seq. (42 U.S.C. 4905, 4912).)

Dated February 23, 1977.

John Quarles,
Acting Administrator.

40 CFR Part 205 is revised, effective May 31, 1977, as follows:

S205.54-1 [Amended]

40 CFR S205.54-1(c)(1)(iv) and 40 CFR S205.54-1(c)(2)(iv) are revoked.

[FR Doc.77-5979 Filed 2-28-77; 8:45 am]

*Note: The deadline of March 14, 1977 for receipt of public comments has been extended to April 20, 1977 by Federal Register notice dated March 21, 1977.

77-3-001

Ford Motor Company

The American Road
Dearborn, Michigan 48121

March 11, 1977

Director
Standards and Regulations Division
Office of Noise Abatement and
Control (AW-471)
Attention: Docket No. ONAC 77-3
U.S. Environmental Protection Agency
Washington, D.C. 20460

Sir:

Ford Motor Company, a manufacturer of medium and heavy trucks, some of which have gross vehicle weight ratings in excess of 10,000 pounds and employ engine brakes, supports the proposed revocation of 40 CFR § 205.54-1(c)(1)(iv) and 40 CFR § 205.54-1 (c)(2)(iv). Ford recommends the following additional editorial changes in 40 CFR § 205.54-1(c) to remove all other references to deceleration testing and engine brakes:

- In §§ 205.54-1(c)(1) and 205.54-1(c)(2), change "Full throttle acceleration and closed throttle deceleration tests are to be used." to "Full throttle acceleration tests are to be used.", and delete "Closed throttle deceleration tests are required only for those vehicles equipped with an engine brake."

- In § 205.54-1(c)(3)(ii), change "The meter shall be observed during the period while the vehicle is accelerating or decelerating." by deleting "or decelerating."

Sincerely,

W. E. Schwieder

15 MAR 77 14:07

77-3-002

MACK TRUCKS, INC.
One of The Signal Companies

March 11, 1977

Director
Standards and Regulations Division,
Office of Noise Abatement and Control (AW-471)
U.S. Environmental Protection Agency,
Washington, D.C. 20460.

Gentlemen:

Attention: Docket No. ONAC 77-3

Mack Trucks, Inc., a manufacturer of heavy duty trucks of 26,000 lbs. GVW and greater, is pleased to submit the following comments for inclusion in Docket No. ONAC 77-3.

Mack Trucks presently offers an optional engine brake, on Mack, turbocharged diesel engines, identified as a "DYNOTARD" engine brake. A review of the results of our current and ongoing noise evaluation program indicates that noise levels measured during the deceleration pass-by test (engine brake actuated) are lower than those measured during the conventional acceleration pass-by.

In view of the above, we concur completely with, and support the action taken by, the Administrator in deleting the deceleration pass-by requirement for trucks equipped with engine brakes, as "being of little environmental benefit because of the limited use and low noise levels of engine brakes".

Very truly yours,

MACK TRUCKS, INC.

John H. Humpton, Jr.
Executive Engineer-
Vehicle Regulations and
Standards

jcb

ISSUED 77 14:03

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WORLD HEADQUARTERS: Engineering Division • P.O. Box 1761 • Allentown, Pa. 18105 • (215) 439-3011 • Telex: 084-74[illegible]

77-3-003

AMERICAN
TRUCKING
ASSOCIATIONS, INC.
1616 P Street, N.W., Washington, D. C. 20036

TECHNICAL SERVICES DIVISION
Richard H. Hinchcliff
Managing Director

ENGINEERING DEPARTMENT
(202) 797-5391

March 11, 1977

Director
Standards and Regulations Division
Office of Noise Abatement and Control
U.S. Environmental Protection Agency
Washington, DC 20460

Docket FRL 684-6 - PART 205 - Transportation Equipment Noise Emission Controls - Medium and Heavy Duty Trucks

Dear Sir:

American Trucking Associations, Inc. (ATA) files these comments in response to the Notice of Proposed Rulemaking in the above-styled proceedings, appearing in the Federal Register, March 1, 1977 (42 Fed. Reg. 11385).

ATA is the national organization of the trucking industry, representing all types of for-hire and private motor carriers of property. As the national representative, ATA is a regular participant in proceedings before the National Highway Traffic Safety Administration, the Interstate Commerce Commission, and the courts. It is a non-stock, non-profit corporation organized and existing under the laws of the District of Columbia, with offices at 1616 P Street, N.W., Washington, DC 20036.

Many of the trucking companies whom ATA represent, particularly those operating in the western states, are quantity users of the Jacobs Engine Brake. The Technical Advisory Group (TAG) to the ATA SCORE Committee, at its last meeting unanimously agreed that ATA should support the petition of the Jacobs Manufacturing Company and the proposed deletion of Section 205.54-1(c)(1)(iv) and 205.54(c)(2)(iv) from 40 CFR Part 205. Certainly we can agree that with the engine brake properly installed and with the requisite attention being paid to adequate muffling by the vehicle manufacturer, the noise created by the engine brake during

MAR 77 12: 20

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deceleration is not high enough to be a contributing factor at the proposed 83 and 80 dBA new truck noise levels, and therefore, the present requirement for deceleration tests on vehicles fitted with such brakes is superfluous in that it would have no environmental or other benefit.

We cannot speak to the attitude of the vehicle manufacturers and the assertion by Jacobs Manufacturing that the requirement for the additional test procedure and the incremental costs involved would inhibit the truck manufacturers from offering the engine brake. It is, however, obvious to us that such additional costs would be very real and would have to be passed on to the consumer - the truck operators in one form or another. Over the last 4 years, the cost of the trucks we must purchase to perform our function has increased by at least 50% and thus we most strongly oppose any unnecessary regulation or facet of a regulation which would serve no useful environmental purpose and would carry with it an adverse cost penalty.

It can also be agreed that the retention of the present additional test requirement with its potential for discouragement of the fitment of engine brake would have adverse safety implications. To indirectly exclude the engine brake from those long downgrade operations where it serves a most beneficial safety purpose would throw an additional burden on the vehicles foundation brakes, and increase the potential for brake fade with possibly disastrous consequences.

We commend EPA on their realistic appraisal of the Jacobs petition and support this proposed rulemaking.

Very truly yours,

William J. K. Gibson
Automotive Engineer
Engineering Department

77-3-004

STATE OF CALIFORNIA—BUSINESS AND TRANSPORTATION AGENCY EDMUND G. BROWN JR., Governor

DEPARTMENT OF CALIFORNIA HIGHWAY PATROL
P.O. BOX 898
SACRAMENTO, CALIFORNIA 95804
(916) 445-1865

March 10, 1977

File No.: 1.A2781.A3579

Director, Standards and
Regulations Division
Office of Noise Abatement
and Control (AW-471)
Attention: Docket No. ONAC 77-3
U.S. Environmental Protection Agency
Washington, DC 20460

Gentlemen:

We offer the following comments for your consideration on the March 1, 1977, Notice of Amendment (FRL 684-6) to Part 205, Transportation Equipment Noise Emission Controls.

California has had no recent problems with exhaust noise from Jacobs brakes. We agree that deceleration noise tests are not always necessary on every vehicle with engine brakes and could be an unnecessary testing expense if conducted on every new vehicle model. However, there may be a few engine designs or future types of engine brakes that could produce excessive deceleration noise.

We recommend that EPA regulations retain authority to run the deceleration test only on special systems that may be suspected of being loud on deceleration as observed when the truck is operated preparatory to other testing. If the deceleration test is completely eliminated, there would be no limit on total noise that a truck could emit on deceleration, with or without an engine brake.

We take exception to the extremely short period allowed for comments. The Notice was dated February 23 but was not printed in the Federal Register until March 1. The Register did not reach Sacramento in the mail until March 7, leaving only four working days for a reply.

Very truly yours,

G. B. CRAIG
Commissioner

15 MAR 77 14:07

77-3-005

FREIGHTLINER CORPORATION
4747 N. CHANNEL AVENUE
P. O. BOX 3849
PORTLAND, OREGON 97208
503 283-5020

ROGER W. SACKETT
Vice President-Engineering

March 14, 1977

Director,
Standards and Regulations Division
Office of Noise Abatement and Control (AW-471)
Attention: Docket No. ONAC 77-3
U.S. Environmental Protection Agency
Washington, D.C. 20460

SUBJECT: Response to Notice of Amendment to Part 205,
Transportation Equipment Noise Emission Controls

REFERENCE: Federal Register 42 F.R.11836, March 1, 1977

Dear Sir:

Freightliner Corporation hereby submits its comments to the amendment to Part 205 which would eliminate an extra passby test with the engine brake applied.

Freightliner is in favor of the amendment. We would, however, like to point out three additional references to testing with engine brakes that were omitted from the amendment, probably inadvertently.

The amendment deletes the following:

1.) 205.54-1(c)(1)(iv)
2.) 205.54-1(c)(2)(iv)

In addition, references to testing vehicles with engine brakes are made in the following:

3.) 205.54-1(c)(1), last sentence: "Closed throttle deceleration tests are required only for those vehicles equipped with an engine brake."
4.) 205.54-1(c)(2), last sentence: (Same as (c)(1), above).
5.) Table IV: "Test data: .....deceleration test:" and section headed "Deceleration test with exhaust brake applied."

22 MAR 77 10:51

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Items 3, 4, and 5 should be modified if items 1 and 2 are deleted.

Yours truly,

FREIGHTLINER CORPORATION

Roger W. Sackett

RWS:skw

77-3-006

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE: Mar 14, 1977

SUBJECT: Proposed Deletion of 40CFR Section 205.54-1C14 and Section 205.54-1C24

FROM: Robert A. Simmons, Supervisor
Noise Control Program (8AH-WM)

TO: Director, Standards and Regulations (AW-471)
Office of Noise Abatement and Control

ATTN: Docket Number ONAC 77-3

There is a very significant environmental benefit resulting from the proper muffling of engine brake noise. Region VIII experiences with the deleterious effects of noise resulting from the operation of engine brakes indicates that such devices do make a significant contribution to truck noise levels during their operation in the field and would hope that such contributions would be reflected by our EPA standards and test procedures.

Engine brakes are an essential safety requirement for the operation of heavy trucks on mountainous and hilly roads, and are therefore very common to this Region.

Following are additional general comments relating to the deleterious environmental impact of the noise produced by the operation of engine brakes and an indication of the environmental benefit which would be produced by the control of such noise.

1) Engine brake noise is a source of predominant complaints received from the public by states and municipalities in Region VIII having or seeking to develop noise control programs and also by this Region Office. Engine brake noise complaints often exceed truck acceleration noise complaints. Some explanations for this phenomenon are listed below.

2) Community noise control officers in Region VIII in the process of routine enforcement do find trucks for which the engine brake noise in their deceleration test is greater than the noise produced by the same vehicle during maximum acceleration tests.

3) The frequency distribution and time modulated amplitudes of the engine brake noise during deceleration is significantly different from the exhaust noise produced by the truck during acceleration. Truck mufflers can be designed to address one or both of these frequency distributions. A truck muffler designed for optimum performance for the acceleration noise may very well not provide the attenuation desired for the frequency distribution of the engine brake noise, therefore suggesting the need to provide noise control standards and testing for both modes of operation.

22 MAR 77 15: 07

EPA Form 1320-6 (Rev. 3-76)

4) Engine brake noise per decibel creates more deleterious effects on the health and welfare of individuals than does truck acceleration noise. The predominant effects experienced in Region VIII are annoyance, sleep interference, speech interference, and startle reflexes. This higher environmental impact of engine brake noise is attributed to the more unique characteristics of the sound produced by the truck in the engine brake mode of operation and by the ambient conditions experienced by receivers of the noise when the engine brake noise is present. More specifically, engine brake noise in comparison to engine acceleration noise contains higher frequencies, more repetitive and cyclic sound characteristics relating to the "sharp, sticatto patterns" of noise produced, and the more abrupt onset of the noise experienced when the engine brake becomes fully engaged. The ambient sound levels experienced by receiving individuals located near portions of the roadway where engine brake noise in the deceleration mode is experienced are normally considerably lower than the ambients experienced by steady state cruise-by or by acceleration mode portions of roadways. This reduced ambient increases the environmental insult of the engine brake noise when an engine brake abruptly becomes and remains engaged, thereby creating a significant potential for annoyance, sleep interference, speech interference, and other physiological and psychological effects associated with startle phenomenon.

5) Although engine brakes are an essential safety feature for heavy trucks operating on long, steep descents, they are not necessary, from a safety standpoint, within communities which do not have such descents. However, use of engine brakes within our communities is commonplace and significant numbers of people are affected by their use. The truck operator must remember to throw the off-switch in his cab in order to disengage the engine brake and must remember to turn it back on again during long, steep decelerations where the engine brake is necessary for safety purposes. Many truck operators either forget to turn the switch off when it is not necessary for safety purposes or find it convenient to leave it on. Therefore, the use of engine brakes in the portions of the country where engine brakes are used is not limited, but can be extensive. Some truck operators may desire, purposely, to leave the engine brake on when operating on level streets within communities or elsewhere in order to allow them to accelerate through the gears faster since the engine brake allows the engine speed to reduce quicker thereby providing a slight decrease in the time required to perform a shift from a lower gear to a higher one. It is also possible that some operators may like to hear engine brake noise--it does something for their genes. These habits are not safety related and can provide a significant environmental noise insult to significant numbers of people.

6) The observations and concerns mentioned above suggest that the pass-by test in the engine brake mode of operation should be retained and this Agency should consider reducing the sound pressure level standard for that pass-by test to more restrictive levels than those required by the maximum acceleration mode of operation.

There has not been adequate time for public comment on this proposed deletion and there appears to be considerable interest in this matter in Region VIII; therefore, we respectfully request a 45-day extension of the public comment period to allow adequate time for preparation and submission of such comments by the public, community and state officials, and of more specific comments from this Regional Office. The Region VIII Noise Control Program received several phone calls from interested community officials on March 11th and 14th, expressing concern about the proposed deletion and their desire to provide EPA with comments, further indicating that the current public comment period was not adequate to provide them with the necessary time to provide EPA with such input. Apparently most state, local and Regional noise control officials have received written notice of this proposed deletion in their offices on March 10th and March 11th, with final comments due to EPA the following Monday, March 14th. In most cases, these officials were notified of this action by the March 7th issue of Noise Control Report which was received in their offices on March 10th or 11th.

We thank you in advance for consideration of our hastily prepared comments and invite you to seek additional clarification if desired.

cc: John M. Ropes (A-104)

77-3-007

ROBERT W. STRAUB
Governor

Department of Environmental Quality

1234 S.W. MORRISON STREET, PORTLAND, OREGON 97205 Telephone (503) 229- 6085

April 15, 1977

Mr. Henry Thomas
Director, Standards and Regulations
Division
Office of Noise Abatement and Control
(AW 471)
U.S. Environmental Protection Agency
Washington, D.C. 20460

Re: Docket No. ONAC 77-3

Dear Mr. Thomas:

Following are the comments of the Oregon Department of Environmental Quality regarding the proposal to rescind the requirements that engine brakes be subject to the test provisions specified in the medium and heavy duty truck noise regulations:

Immunity from state and local regulation has been established for various truck noise sources, including exhaust-engine brakes. These are, instead, Federally regulated under the interstate motor carriers noise standards. The preemption provisions of these regulations provide for exclusive Federal control unless identical regulations have been adopted at the state or local level, or an exception to preemption has been granted under the provisions for "special local determinations." For all practical purposes then, local or state control in this area is precluded. If protective standards are to be implemented, it must be done at the Federal level, or not at all. This latter possibility concerns us.

We believe that operation of exhaust-engine brakes, installed on new trucks otherwise required to comply with Federal new truck regulations, should be included in the testing procedure used to establish that vehicle's noise rating for purposes of certification. If these sources are regulated under the in-use standards, it seems reasonable that they should also be subject to the new vehicle standards.

Oregon receives many complaints concerning the operation of "Jake Brakes." The state presently requires new trucks equipped with "exhaust brakes" to be tested with the brakes in full use during the deceleration portion of the test as part of certification. This has not caused adverse comment to be received from truck manufacturers. However, the requirement has had a positive impact on the number of complaints received due to exhaust brake operation.

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In conclusion, to discontinue control of exhaust brakes on new trucks subject to Federal preemption would be unwise. Including exhaust brakes has not placed an unreasonable burden on truck manufacturers, yet discontinuance would have the effect of increasing the number of people disturbed by this source while preventing state or local jurisdictions from filling the enforcement gap thus created. Approval of this proposal would not be a step in the right direction.

Thank you for the opportunity to submit our comments.

Sincerely,

WILLIAM H. YOUNG
Director

John Hector
Supervisor
Noise Pollution Control Section

NDS:dro

77-3-008

Department of Environmental Protection
Division of Resource Protection

MONTGOMERY COUNTY, MARYLAND
ROOM 340, 6110 EXECUTIVE BOULEVARD, ROCKVILLE, MARYLAND 20852

April 14, 1977

Henry E. Thomas, Director
Standards and Regulations Division
Office of Noise Abatement and Control
(AW-471) Attention: Docket #ONAC77-3
U.S. Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

The proposed amendment to 40 CFR Part 205 omitting 40 CFR S205.54-1(c)(1)(IV) and 205.54-1(c)(2)(IV) is well taken. We concur with the action of the Environmental Protection Agency in response to the petition for reconsideration submitted by the Jacobs Manufacturing Company.

As long as the noise levels produced by the engine brakes are significantly less than the other major noise sources, the addition of the engine brake test is not important. However, when engine brakes do become major truck noise sources, when compared to the rest of the noise producing elements of vehicles, the engine brake tests should be reinstituted. We question how EPA will determine at what point the engine brake will become a major noise source and what is to prevent manufacturers from neglecting noise controls (if required) on engine brakes if there is no federal regulation and/or test procedure to control/measure the noise produced by the brakes.

Sincerely yours,

Richard J. Peppin
County Acoustical Engineer
Air Pollution and Noise Control Section

RJP:sdc

[illegible] 19 APR 77 13:39

77-3-009

INTERNATIONAL HARVESTER

April 20, 1977

Mr. H. E. Thomas
Director, Standards & Regulations Div.
Office of Noise Abatement and Control (AW-471)
Environmental Protection Agency
Crystal Mall, Bldg. 2
1921 Jefferson Davis Highway
Arlington, Virginia 20460

Dear Mr. Thomas:

In response to Docket Number ONAC 77-3, which calls for deletion of 40 CFR Paragraphs 205.54-1(c)(1)(iv) and 205.54-1(c)(2)(iv), International Harvester offers the following comments. Deletion of these paragraphs would remove the necessity for performing deceleration tests on all medium and heavy duty trucks during Selective Enforcement Audits when such trucks are equipped with exhaust brakes. International Harvester supports the deletion of these paragraphs. It has been our experience that vehicles equipped to meet the 1978 Federal Noise requirements during acceleration testing create no more noise during the deceleration test; therefore, the deceleration testing is an unnecessary burden on the manufacturer and provides no benefit for the community and/or our customers.

In order to support this position we submit the following data on 10 vehicles tested both under the acceleration and deceleration procedure. These vehicles were equipped with exhaust and cooling systems typical of those that will be produced after January 1, 1978.

Vehicle	Model	Engine	Accel Minus Decel 8 Pass Average
1	Paystar	Cummins NTC-350	+.7
2	Paystar	Cummins NTC-350	-.1
3	Paystar	Cummins NTC-350	+1.3
4	Conventional Transtar	Detroit Diesel 8V92T	+.1
5	Conventional Transtar	Detroit Diesel 8V92T	-.2
6	Conventional Transtar	Cummins Formula-350	-.2
7	Conventional Transtar	Cummins NTC-350	-.3
8	Conventional Transtar	Cummins NTC-350	+1.1
9	Transtar II	Cummins NTC-350	+1.3
10	Transtar II	Cummins NTC-350	+3.2
	AVERAGE		+.69

TRUCK DIVISION ENGINEERING 2911 Meyer Road Fort Wayne, Indiana 46803 Phone 219 461-5128
Address reply to P.O. Box 1109 Fort Wayne, Indiana 46801

5 APR 77 11:05

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This sample is somewhat limited due to the number of vehicles with exhaust brakes that were available. The data provided is the arithmetic average of 8 passes for each vehicle. We feel this is a most accurate method of evaluation for comparing procedures. As the table indicates, noise produced from the acceleration test on the average was more than 1/2 dB(A) higher than that produced during the deceleration test. In no case did the average noise value from the deceleration test exceed .3 dB(A) more than the noise obtained from the acceleration test. Since .3 dB(A) is well within experimental error, the negative values do not indicate that noise from the deceleration test was higher than that from the acceleration test.

Our experience has shown that in the case of vehicles with overall truck noise levels higher than 83 dB(A) where fan and exhaust noise are predominant, that noise levels during the deceleration test can be higher than those from the acceleration test. Our experience has also shown, as the data above indicates, that once the truck noise level is reduced to meet the Federal 1978 and 1982 Standards, the deceleration noise levels are equal to or lower than the acceleration levels. Therefore, International Harvester supports EPA's conclusion that, "...the noise contributed by engine brakes during deceleration is not high enough to be a contributing factor, and therefore the additional passby with the brake engaged adds nothing to the test. This being the case, there is no environmental benefit to offset any additional burden which the requirement may impose."

I hope that the above is helpful in justifying the deletion of the paragraphs in question. If we can be of further assistance, please don't hesitate to contact me or Mr. R. F. Ringham, Corporate Vice President, Technical Affairs (202-296-7890).

Very truly yours,

N. A. Miller (219/461-5211)
Staff Engineer - Sound & Energy

lw

77-3-010

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Bakersfield 323-6053
Tulare 686-8578

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April 20, 1977

Director, Standards and Regulations Division
Office of Noise Abatement and Control (AW-471)
Attention: Docket No. ONAC 77-3
U.S. Environmental Protection Agency
Washington, D.C. 20460

Dear Sir:

My comment on the Jacobs Brake are that this was and is the greatest equipment to put on equipment.

Many trucks in the years before this Jacob Brake was manufactured would lose breaking power due to heat on the braking drums and then brake lining catching fire. In many of these cases bad accidents resulted from no control of the equipment.

Our company runs over the ridge route and this is where I have seen what happened. I know there must be many hills greater than this route.

I believe that this Jacob Brake should <u>not be used in the cities</u> unless necessary as they are noisey and in most cases not needed.

The cost factor is another advantage to trucking as the brake lining is very costly and ties equipment up while doing a job that would not have to be done as much. In fact we get 3 times more us of the brake lining.

For many years trucking had been looking for something to help runaways. Please do not take it away.

Sincerely yours,

J. L. Chase

J.L. Chase
President
Kern Valley Trucking

JLC/cf

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28 APR 77 11 28

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 77/348

APR 27 1977

Dear Sir:

We have reviewed your notice, dated February 23, 1977, concerning noise emission standards for medium and heavy trucks, which proposes to amend 40 CFR Part 205 by deleting 205.54-1(c)(1)(iv) and 205.54-1(c)(2)(iv). We have no other comment accept to note that the determination of the Administrator to presently delete these sections and to consider the engine brake issue when future, more stringent noise standards are considered, appears to be technically sound and reasonable.

We appreciate the opportunity to comment on this amendment.

Sincerely yours,

Heather L. Ross

Acting Deputy Assistant Secretary of the Interior

Director, Standards and
Regulations Division
Office of Noise Abatement
and Control (AW-471)
Attention: Docket No. ONAC 77-3
Environmental Protection Agency
Washington, D. C. 20460

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

APR 77 15 42

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77-3-012

CITY OF BOULDER, COLORADO 80302

March 31, 1977

Director, Standards and Regulations Division
(AW-471)
U.S. Environmental Protection Agency
401 M. St. S.W.
Washington, D.C. 20460

Re: Jacobs Manufacturing Company Request for Deletion of Deceleration Test.
(40 CFR Section 205.54-1C14 and Section 205.54-1C24)

Dear Sir:

The test in question is a most critical one here in our mountainous area where the necessity of the Jacobs Brake for safety is an absolute must. Most large trucks in this area are equipped with this device and most drivers use it, not only to achieve a retarding engine action on long downhill grades; but also to assist in achieving a downshift in the transmission while driving in town. In both of these uses the Jake Brake causes the exhaust note of the engine to shift in frequency and, if not properly muffled, to emit sound levels which are intolerable.

I have had occasion to issue a noise violation summons to a truck decelerating with the Jake Brake in our City emitting a level of 97 dBA at a distance of 75'. The vehicle was equipped with a muffler, although an inadequate one. On the installation of a proper muffler, this truck was tested and the following levels were recorded.

At 25' accelerating in first gear (under 35 mph)	87 dBA.
At 25' accelerating in second gear (under 35 mph)	86 dBA.
At 25' decelerating from 35 mph using the Jake Brake	87 dBA.

The summons was dismissed. The truck, when properly muffled, can perform as quietly in the decelerating mode as in the accelerating mode. It should not be considered a hardship on the manufacturer to provide an adequate muffler on his product that will accomplish the necessary control of noise. Also, it should not be considered a hardship to test these components in operation to assure that noise control is accomplished.

In the Jacobs Company request to delete the test no mention was made of the truck under test being properly muffled. In order to really determine if a vehicle is properly muffled, tests in the acceleration and deceleration modes, due to the frequency shift of the exhaust note, must be performed. Once an appropriate muffler is found for that vehicle, then the test would not be necessary on every vehicle manufactured as long as the appropriate muffler was specified and used.

Reproduced from best available copy.

The requirement of an appropriate muffler on every truck, including those equipped with a Jake Brake, will cause an immediate improvement in the environment of many small mountain communities that do not have an enforceable effective noise ordinance. Also, this action will assist the E.P.A. to achieve the desired eventual goal of an Ldn of 55 dBA.

I request that the deceleration test for trucks equipped with Jacobs Brakes not be deleted in it's entirety.

Very truly yours,

James V. Adams

James V. Adams,
Environmental Protection Officer

cc: Robert Westdyke, City Manager
Andy Hollar, Director, Public Facilities
Pete Hansel, Director, Operations
Charles L. Elkins, D.A.A. O.N.A.C. U.S.E.P.A.
John A. Green, Regional Administrator, U.S.E.P.A. Region VIII
Robert A. Simmons, Supervisor, Region VIII Noise Office

77-3-013

Arent, Fox, Kintner, Plotkin & Kahn

Federal Bar Building, 1815 H Street, N.W.
Washington, D.C. 20006

Cable: AFKPOX
Telex: 892672
Telephone: (202) 857-6000

Writer's Direct Dial Number

(202) 857-6053

May 12, 1977

Mr. Henry E. Thomas
Director
Standards and Regulation Division
Office of Noise Abatement
and Control (AW-471)
U. S. Environmental Protection Agency
Washington, D. C. 20460

Attention: Docket No. ONAC 77-3 --
Medium and Heavy Duty Trucks --
40 Federal Register 11835
(March 1, 1977)

Dear Mr. Thomas:

This comment is submitted on behalf of Jacobs Manufacturing Company in response to the comments submitted by interested parties with regard to the above referenced docket. While we are aware that the official comment period expired on April 20, 1977, Jacobs is identified in the Federal Register as the petitioner seeking deletion of 40 C.F.R. §§205.54-1(c)(1)(iv) and 205.54-1(c)(2)(iv), and accordingly believes that it is appropriate to comment on submissions to the agency relative to the deletion. See 40 Fed. Reg. 11835 (March 1, 1977). Copies of this letter are being forwarded to all persons who submitted official comments to the agency on the deletion.

Of the nine comments submitted in response to the Federal Register publication, only two commentors opposed the agency's action. Those persons favoring deletion were the Montgomery County, Maryland Department of Environmental Protection; Ford Motor Company; Mack Trucks, Inc.; American Trucking Associations, Inc.; International Harvester Corp.; and Freightliner Corporation. The Department of California Highway Patrol also supported the deletion except in exceptional cases.

12 MAY 77 15:35

Two commentors supporting the deletions correctly stated that 40 C.F.R. §§205.54-1(c)(1); 205.54-1(c)(2); 205.54-1(c)(3)(ii), and Table IV also should be amended to reflect the changes in the testing regulations. Jacobs concurs in these conforming recommendations.

Only two comments opposed the deletion of the testing requirements with the engine brake engaged. Neither of these comments, however, justifies a change in the agency's action.

First, the State of Oregon Department of Environmental Quality opposes the change because it "would have the effect of increasing the number of people disturbed by this source while preventing state or local jurisdictions from filling the enforcement gap thus created." This conclusion, however, is invalid for two reasons. First, the Noise Control Act does not preclude states from regulating the operation of trucks with engine brakes. It provides only that new trucks need not be tested with the engine brake engaged in order to be certified under Federal rules. It does not prevent states from regulating the use, operation or movement of trucks. Second, Oregon appears to ignore the fact that the positive power muffling required under the Federal test procedure will assure that the use of engine brakes does not result in excessive noise. This is a critical fact that will assure the effectiveness of the Federal test without the engine brake engaged.

The only other comment opposing the deletion was filed by Robert A. Simmons, Supervisor of the EPA Noise Control Program in Region VIII. Jacobs' response to each of Mr. Simmons' points is as follows:

(1) Mr. Simmons states that engine brake noise complaints often exceed truck acceleration noise complaints. However, the data presented on Page 16 of the Petition of Jacobs Manufacturing Company for Reconsideration of Medium and Heavy Truck Noise Emission Regulation, dated June 4, 1976 (hereinafter referred to as "Jacobs Petition"), contradict this statement. Additional data are supplied in Table 5.2 of Appendix B in the said Petition. Greig, "The Jacobs Engine Brake," Retarders for Commercial Vehicles (1974). These data show that a vehicle which is properly muffled for positive power operation, i.e. acceleration, is also properly muffled for the reduction of any engine brake generated noise.

(2) Mr. Simmons asserts that community noise control officials do find trucks for which the engine brake noise is greater than the noise produced by the same vehicle at maximum acceleration. This comment, however, fails to set forth the actual magnitude of the maximum acceleration noise. Jacobs has conceded that improperly muffled vehicles may produce engine brake noise greater than the positive power noise. These occasions have been investigated by Jacobs. The vast majority of such cases occur when the vehicle contains only straight pipes. Again referring to Page 16 of the Jacobs Petition, it is obvious that the installation of a sound muffler, which is now required under Federal regulations, has a dramatic effect on both engine brake and acceleration noise. Consequently, it would appear that the vehicles referred to by Mr. Simmons were not properly muffled for maximum acceleration power.

(3) Mr. Simmons in this comment refers to the frequency distribution and amplitude of the engine brake noise, and states that truck mufflers with good acceleration muffling may not have good deceleration muffling. However, Exhibit B, Figure 5.11 attached to the Jacobs Petition clearly demonstrates that the magnitude and frequency of engine brake noise energy is consistent in form with the positive power noise energy. The contention of a significant difference between the two is not supported by data. Trucks produce positive power noise along the full spectrum of hearing. The data indicate that the majority of this noise energy is in the frequency range of 60 - 2000 Hertz. The same is true for the engine brake. In fact, since engine brake noise results from the release of compressed gases at distinct points in the engine cycle, and since positive power noise is also created by the release of compressed gases during the engine cycle, there should be no real difference in the frequency distribution of the two noise energies. Neither the frequency nor amplitude of the noise energy differs significantly between the brake and positive power noise emissions. A muffler which is good for one is very obviously good for the other.

(4) In this comment Mr. Simmons contrasts the characteristic sounds of engine brake noise with the characteristic sounds of positive power noise. The comment implies that on the downgrade of the hill people do not expect to hear noise and are more perturbed by the engine brake than they are if they live on the upgrade side of the hill and expect to hear acceleration noise. This comment is completely subjective and unsupported by data. Moreover, of course, it should be noted that for each truck going down the grade there is another one in the opposite lane going up the grade. Therefore, the implication that receiving individuals who are located at different locations should be treated differently has little merit.

(5) Lastly, Mr. Simmons refers to the driving habits of truck operators and the apparent enjoyment they receive from operating their engine brake in unlikely places. Like the above comment, this is entirely subjective, it is not substantiated by data, and it should be rejected. In any event, inappropriate operation of vehicles can, of course, be corrected by state and local regulation.

* * * * *

The comments mentioned in this letter are the only ones which have been submitted for the public record. Most support the deletion of the engine brake test requirements, and the other two contain no substantive data that question it. None of the comments questions the significant safety benefits of the engine brake.

For these reasons, as well as those stated in the Jacobs Petition and the March 1 Federal Register, Jacobs Manufacturing Company believes that the deletion of 40 C.F.R. §§205.54(c)(1)(iv) and 205.54-1(c)(2)(iv) was correct, and that the amendment should take effect as scheduled on May 31, 1977.

Respectfully submitted,

Marc L. Fleischaker

Marc L. Fleischaker
Counsel for
Jacobs Manufacturing Company

cc: All Parties of Record

77-3-014

FREIGHTLINER CORPORATION
4747 N. CHANNEL AVENUE
P. O. BOX 3849
PORTLAND, OREGON 97208
503 283-6020

Bonnie W. Slattery
Vice President-Engineering

April 18, 1977

Director,
Standards and Regulations Division
Office of Noise Abatement and Control (AW-471)
Attention: Docket No. ONAC 77-3
U.S. Environmental Protection Agency
Washington, D.C. 20460

SUBJECT: Comments on Amendment to Delete Test Requirement

REFERENCE: Part 205, Transportation Equipment Noise Emission Control Controls

Dear Sir:

This letter responds to the notice which appeared in the Federal Register (Vol. 42, No. 40, 11836) on Tuesday, March 1, 1977, amending the subject standard and inviting comments with respect to the effect of engine brake noise during vehicle deceleration. Freightliner Corporation is in favor of the amendment.

Freightliner experience supports the findings of the Jacobs Manufacturing Company as reported in the notice and the determination by the Administrator that noise caused by engine braking during deceleration is substantially lower than the noise emitted by the same vehicle under full throttle acceleration. Freightliner has tested two general classes of heavy duty diesel engines with respect to this subject:

1. 8 cylinder, V type, two cycle, turbocharged, in both 300 and 400 horsepower configurations.

2. 6 cylinder, in-line, four-cycle, turbocharged, in a 290 horsepower version.

The two-cycle engines (1) emitted 3 to 4 dBA lower noise levels in engine brake deceleration tests than in comparable full throttle acceleration tests.

The four-cycle engines (2) emitted 6 decibels lower in engine braking tests.

RECEIVED
APR 25 1977

In all tests discussed here, the noise emission levels under engine braking deceleration were 80 dBA or lower. All such tests were run under the conditions specified by Part 205.

It is our conclusion that for the types of turbocharged diesel engines used in heavy duty vehicles, the contribution of noise emitted by the Jacobs engine brake is of such a low order of magnitude compared to the noise emitted by the same engine under full power acceleration that the special passby test would serve no useful purpose in testing for compliance under the present standards. For this reason, Freightliner supports the amendment to delete the deceleration passby test.

Yours truly,

FREIGHTLINER CORPORATION

Roger W. Sackett

RWS:skw

CALIF DEPT HEALTH
2151 BERKELEY WAY
BERKELEY CA 94704

western union Mailgram

1-016507M069 03/10/77 ICS IPMBLSA BERK WSHA
01022 MGM BERKELEY CA 380 03-10 225P PST

CHARLES L ELKINS, US ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF NOISE ABATEMENT AND CONTROL AW 471
WASHDC 20460

FOLLOWING SENT 3-10-77
JOHN QUARLES ACTING ADMINISTRATOR ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON DC 20460
REFERENCE YOUR NOTICE DATED FEBRUARY 23, 1977 AMENDING 40 CFR
PART 205 STRIKING 40 CFR 205.54-1 (C) (1) (IV) AND
205.54 (C) (2) (IV). (FEDERAL REGISTER, VOL. 42, NO 40, MARCH
1, 1977.)
IT IS WIDELY RECOGNIZED AND IT HAS LONG BEEN THE OBSERVATION OF THIS
OFFICE THAT COMMUNITY REACTION TO TRUCK DECELERATION NOISE IS GR-
EATLY EXACERBATED WHEN SOME ENGINE BRAKES SYSTEMS ARE APPLIED. THIS
MAY BE DUE TO THE IMPULSIVE CHARACTER OF THE NOISE BUT THE PHEN-
OMENON NEEDS ELUCIDATION. ALSO, WHILE AVAILABLE DATE SHOW THAT
ENGINE BRAKE DECELERATION NOISE LEVELS ARE USUALLY 1
OR 2 DB LESS THAN MAXIMUM ACCELERATION NOISE LEVELS DETERMINED BY
SAE J366B TEST, COMPLAINTS TO THIS OFFICE INDICATE THAT AT LOWER
RATES OF ACCELERATION AND DECELERATION (CITY TRAFFIC CONDITIONS)
WNGINE BRAKE DECELERATION NOISE IS MUCH MORE OFFENSIVE.
AGAIN, ELUCIDATION IS NEEDED. DISPARITY BETWEEN PUBLIC REACTION
TO ENGINE BRAKE DECELERATION NOISE AND NOISE LEVELS DETERMINED
BY SAE J366B TEST SUGGESTS THAT THE TEST MAY BE AN
INAPPROPRIATE MEANS OF EVALUATING THE OFFENSIVENESS OF THIS
PARTICULAR NOISE. UNTIL SUCH ANOMALIES ARE RESOLVED, DELERTION OF
THE DECELERATION TEST IS UNWARRANTED AND UNWISE. RATHER, THE
TEST SHOULD BE REFINED AND MADE TO CORRELATE WITH THE
OFFENSIVENESS OF THE NOISE IT PROPOSES TO ASSESS.
PUBLIC REACTION SUGGESTS THAT ENGINE BRAKE DECELERATION
NOISE LEVELS PROBABLY SHOULD BE LESS THAN ACCELERATION LEVELS
FOR EQUAL ACCEPTABILITY. CALIFORNIA LAW REQUIRES A DECELERATION
TEST WHENEVER DECELERATION NOISE APPEARS EXCESSIVE. THE DEPARTMENT
OF HIGHWAY PATROL FINDS THIS PROVISION A VALUABLE AND
USEFUL MEANS OF EVALUATING DECELERATION NOISE WHETHER DUE
TO ENGINE BRAKES OR OTHER CAUSES. SUBJECT AMENDMENT WOULD
PREEMPT THIS REQUIREMENT AND DENY OUR CITIZENS ITS PROTECTION.
IN VIEW OF THE FOREGOING, THE OFFICE OF NOISE CONTROL,
CALIFORNIA STATE DEPARTMENT OF HEALTH, URGENTLY RECOMMENDS
THAT THE AMENDMENT BE RESCINDED AND THAT EPA CAUSE AN
INVESTIGATION TO BE MADE TO DETERMINE THE RELATIVE OFFENSIVENESS
OF ENGINE BRAKE DECELERATION NOISE, TO DEVISE AN APPROPRIATE
TEST PROCEDURE FOR EVALUATING SUCH NOISE, AND TO ESTABLISH LEVELS
FOR SUCH NOISE WHICH SHOULD NOT BE EXCEEDED

TO REPLY BY MAILGRAM, SEE REVERSE SIDE FOR VALIDATION UNIQUE TOLL-FREE PHONE NUMBERS

77-3-015

PAGE 2

western union Mailgram

A E LOWE, CHIEF OFFICE OF NOISE CONTROL CALIFORNIA STATE
DEPARTMENT OF HEALTH
2151 BERKELEY WAY BERKELEY CA 94704.

18:15 EST

MGMCOMP MGM

TO REPLY BY MAILGRAM, SEE REVERSE SIDE FOR WESTERN UNION'S TOLL-FREE PHONE NUMBERS

APPENDIX B

LETTER FROM JACOBS MANUFACTURING CO.
DATED July 25, 1974

The JACOBS Manufacturing Company

WEST HARTFORD, CONNECTICUT 06110 U.S.A.

July 25, 1974

Dr. Alvin F. Meyer
Deputy Assistant Administrator
Office of Noise Abatement and Control
Mail Code AW 571
Environmental Protection Agency
401 M.Street, S.W.
Washington,D.C. 20460

Dear Dr. Meyer:

The Jacobs Manufacturing Company is the only manufacturer of compression retarders. Twenty five per cent of the large trucks on the West Coast use compression retarders. Compression retarders can contribute significantly to total vehicle noise during deceleration and must be accounted for in noise tests. The Jacobs Engine Brake is used to control vehicle speed down long grades and to help decelerate vehicles to a stop. If a vehicle is permitted to emit excessive noise during these periods it will have a detrimental effect on our environment.

The Jacobs Manufacturing Company is interested in amending or changing Section 202.13 of the Environmental Protection Agency's Part 202 of Title 40 of the Code of Federal Regulations establishing noise emission standards for motor carriers engaged in interstate commerce. The change would be to incorporate the measurement of noise with the vehicle in a stationary position when the engine is decelerated from governed speed to idle, which will effectively measure the Jacobs Engine Brake noise. We propose the following additional wording be added to Section 202.13:

a) No person shall operate a motor vehicle which is powered by an engine with engine speed governor which generates more noise than 88 DB(A) measured at 50 feet from vehicle centerline when that engine is accelerated from idle with wide open throttle to govern speed, remaining at govern speed for three to five seconds then decelerating from govern speed to idle with throttle closed with the vehicle stationary, transmission in neutral, and clutch engaged.

Section 202.11 regulates the noise generated by the Jacobs Engine Brake during deceleration of the vehicle. Jacobs feels that omitting the stationary deceleration test was an oversight or inaccurate assumption that stationary deceleration would always produce less noise than the stationary run up condition, but this is not always the case. Jacobs has data available

The Jacobs Manufacturing Company

illustrating that it is possible in the stationary test to have a 10 DBA increase in the engine deceleration portion of the test with the Jacobs Engine Brake actuated over the engine acceleration portion of the test. This is possible because some particular types of mufflers attenuate engine acceleration or power noise but do nothing to attenuate Jacobs Brake noise. The above offenders could be detected in a highway operation (Section 202.11) but not in the stationary test (Section 202.13) as proposed. It is also our understanding that the proposed S.A.E. procedure of the stationary test includes a deceleration phase.

Jacobs believes, in the long range, it is in our best interest to have mufflers that properly attenuate compression brake noise, installed on all vehicles that are equipped with Jake Brakes.

We would like to plan a trip to Washington in the near future to meet with you and/or members of your staff at your earliest convenience to discuss the possibility of the proposed regulation change. I will be contacting you in the near future by phone to set up a meeting.

R.B. Price

R.B. Price
Project Engineer

REP: eg

cc: Mr. Henry Thomas, Acting Director of Standards and Regulations Division
Mr. David Weiner, Office of Noise Abatement and Control
W.H. Morse
A.P. Papanek
G.E. Jerome
D.B. Sandstrom
F. Stawski

APPENDIX C

TRANSCRIPTION OF VOICE ON REGION VIII UNITED STATES ENVIRONMENTAL PROTECTION AGENCY DEMONSTRATION TAPE RECORDING OF ENGINE BRAKE OPERATIONAL NOISE FROM AN UNMUFFLED KENWORTH TRUCK

APPENDIX C

TRANSCRIPTION OF VOICE ON REGION VII
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
DEMONSTRATION TAPE RECORDING OF ENGINE BRAKE
OPERATIONAL NOISE FROM AN UNMUFFLED KENWORTH TRUCK*

Recorded: Boulder, Colorado
April 13, 1977
Full Track Recording

VOICE #1 (William Bryant; Region VIII USEPA)

"This recording features the noise of an engine brake on a heavy truck. All of the original tape except the final segment was recorded on two tracks with a Nagra Model IV-SJ tape recorder with channel 2 attenuated 20 dB more than channel 1. The final segment was recorded full track on a Nagra Model IV-D tape recorder. For level calibration, a 1000 Hertz signal will follow at 92.8 dB on track 1 and 112.8 dB on track 2. Recalibration will be required before the final segment of the tape."

CALIBRATION SIGNAL*

VOICE #2:

"Two vehicles and three instruments used in this demonstration of heavy truck engine brake noise were made available by the Environmental Protection Office of the city of Boulder, Colorado. The demonstration was observed by representatives of the United States Environmental Protection Agency, Office of Noise Abatement and Control, and the resulting sound levels were recorded by Region VIII personnel of the United States Environmental Protection Agency."

"Instrumentation included 3 GenRad Model 1933 sound analysis systems using 1 inch electret microphones. One Model 1933, with flat weighting, provided a signal to a Nagra Model IV-SJ analog tape recorder with flat weighting. A second Model 1933 with A-weighting provided input to a Hewlett-Packard Model 7155A strip chart recorder; and a third, with flat weighting, was used in the cab of the principal truck as input

* Level recordings for unweighted (linear), C-weighted, and A-weighted sound levels of the data presented in Noise Events 1 through 5 are presented at the end of the transcription.

VOICE #2 (Continued)

for a Nagra Model IV-D analog tape recorder. Excepting the verbal comments and, as will be noted later, the in-cab recording, all levels on the original tapes are believed to be in true relation to the calibration signal within $\pm$ 1 or perhaps 2 dB."

"There is some non-linearity at the peak sound levels. For the roadside recordings, the microphones were 4 feet above the ground on tripods and 50 feet from the downhill lane of the access road to the National Center for Atmospheric Research at Boulder, Colorado. The microphones were 62 feet from the uphill lane. This added distance of 12 feet should account for nearly 2 dB of attenuation from uphill traffic relative to downhill traffic noise. The road surface was dry asphalt and its grade was a nearly constant 9%, or about 5^{o}."

"The microphone surroundings, within acoustic range, were relatively flat and unobstructed. The ground surface was thinly covered with native grasses and small rocks. Temperatures ranged from 7^{o} to 15^{o} C. Wind varied from 5 to 11 kilometers per hour. Most of the recorded sounds of concern were generated by an 18,500 pound Kenworth truck pulling a 9,500 pound flat-bed semi-trailer. It was powered by a 262 cubic inch Cummins diesel engine, governed at 2150 rpm, and it had a 15-speed transmission system. The truck was equipped with an engine brake capable, at the driver's option, of braking with 2, 4 or 6 cylinders. The exhaust was a single four and one-half inch straight pipe, 8 feet high on the right hand side of the vehicle, with a turbo-charger chamber and no muffler."

"Another truck, referred to later as a water truck, was a 37,000 pound International Trans-Star with a 262 cubic inch Cummins diesel engine governed at 2100 rpm. It had a 15-speed transmission system, no engine brake, and dual three inch exhaust pipes with Donaldson mufflers. Downhill speeds in this exercise were approximately 35 miles per hour. The first example of truck noise was recorded as the Kenworth accelerated uphill, past the microphone at 20 miles per hour, full throttle, and 2000 rpm. Transmission was in second gear and over. The sequence

VOICE #2 (Continued)

of events is an automobile going uphill, peaking at 63 dBA; the water truck going downhill peaking at 79 dBA, and then the Kenworth going uphill, peaking at 83 dBA. (Ed. Comments - There appears to be a vehicle pass-by and distant truck braking sounds during the last 16 to 20 seconds of event. These sound levels are in the range of 55 to 65 dBA.)

NOISE EVENT 1

VOICE #3:

"Next we hear the Kenworth going downhill at 1900 rpm without engine brake. The Kenworth peaking at 79 dBA is followed by a Scout-type vehicle sputtering at about 63 dBA. A few seconds later we hear the engine brake applied one third of a mile away. That's 59 dBA at the microphone."

NOISE EVENT 2

VOICE #4:

"The next downhill passage, in third gear direct at 2150 rpm, 4 cylinders of the engine brake were engaged abeam of the microphone, peaking at 97 dBA."

NOISE EVENT 3

VOICE #5:

"Here comes the Kenworth using the engine brake all the way down the hill. 97 dBA at the passage."

NOISE EVENT 4

VOICE #6:

"During the following passage, the Kenworth applies 4 cylinders of braking before arrival and, abeam of the microphone, shifts to 6 cylinders peaking at 97 dBA."

NOISE EVENT 5

VOICE #7:

"Now that we have heard something of the impact of an improperly muffled engine on the environment, let's have a brief example of the truck driver's workplace while braking with 4 cylinders en route downhill. First we must recalibrate the sound level. A 1000 Hertz signal is recorded at 112.8 dB."

CALIBRATION SIGNAL

VOICE #8:

"During the following ride in the Kenworth's cab, the right side window is opened and closed twice, but you'll know when. The level is 95 dBA with window closed and 107 dBA with window open. At the end of the run the driver shifts from 4 cylinder braking to 6."

NOISE EVENT 6

VOICE #9:

"In conclusion, the following remarks are offered by Jim Adams, Environmental Protection Officer of the city of Boulder, Colorado."

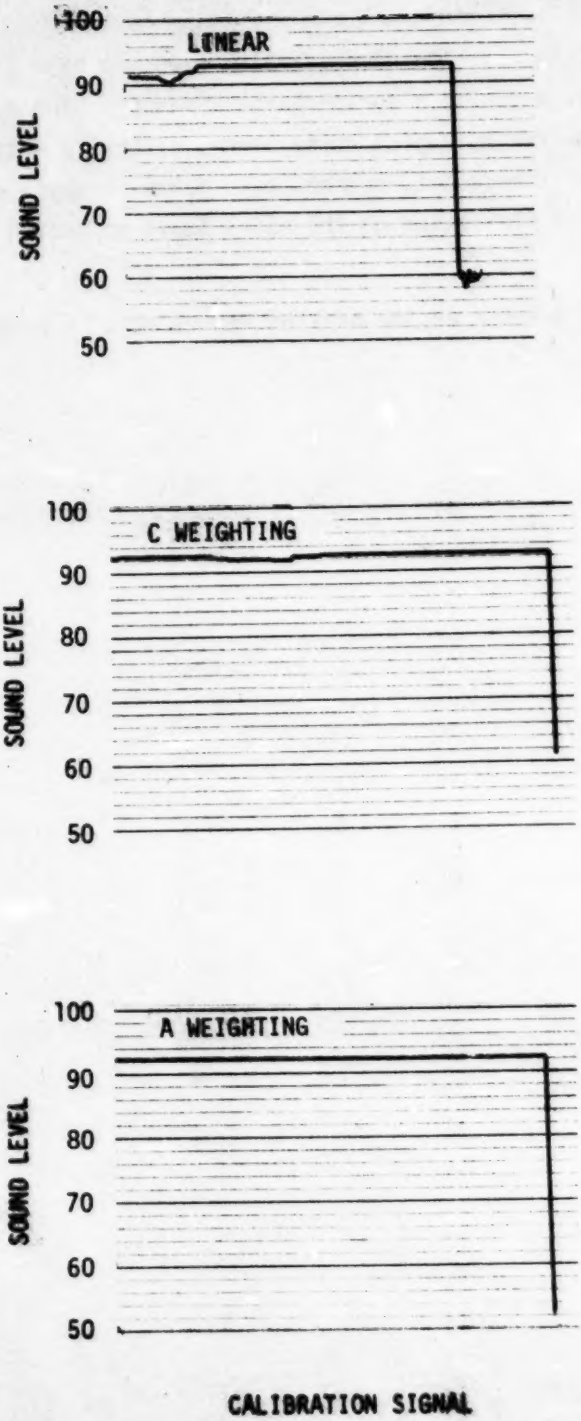
Adams:

"The dynamic engine brake is an absolute necessity for safe mountain

VOICE #9 - Adams (Continued)

operation of heavy trucks. The demonstration tape you have just heard is without a muffler and with a turbo-charger chamber. The aural comparison of the decelerating engine noise alone, without a muffler and then the addition of the dynamic engine brake makes it quite obvious the extreme impact of the device on the noise level generated by the truck."

"In conclusion, the dynamic engine braking device must be properly muffled."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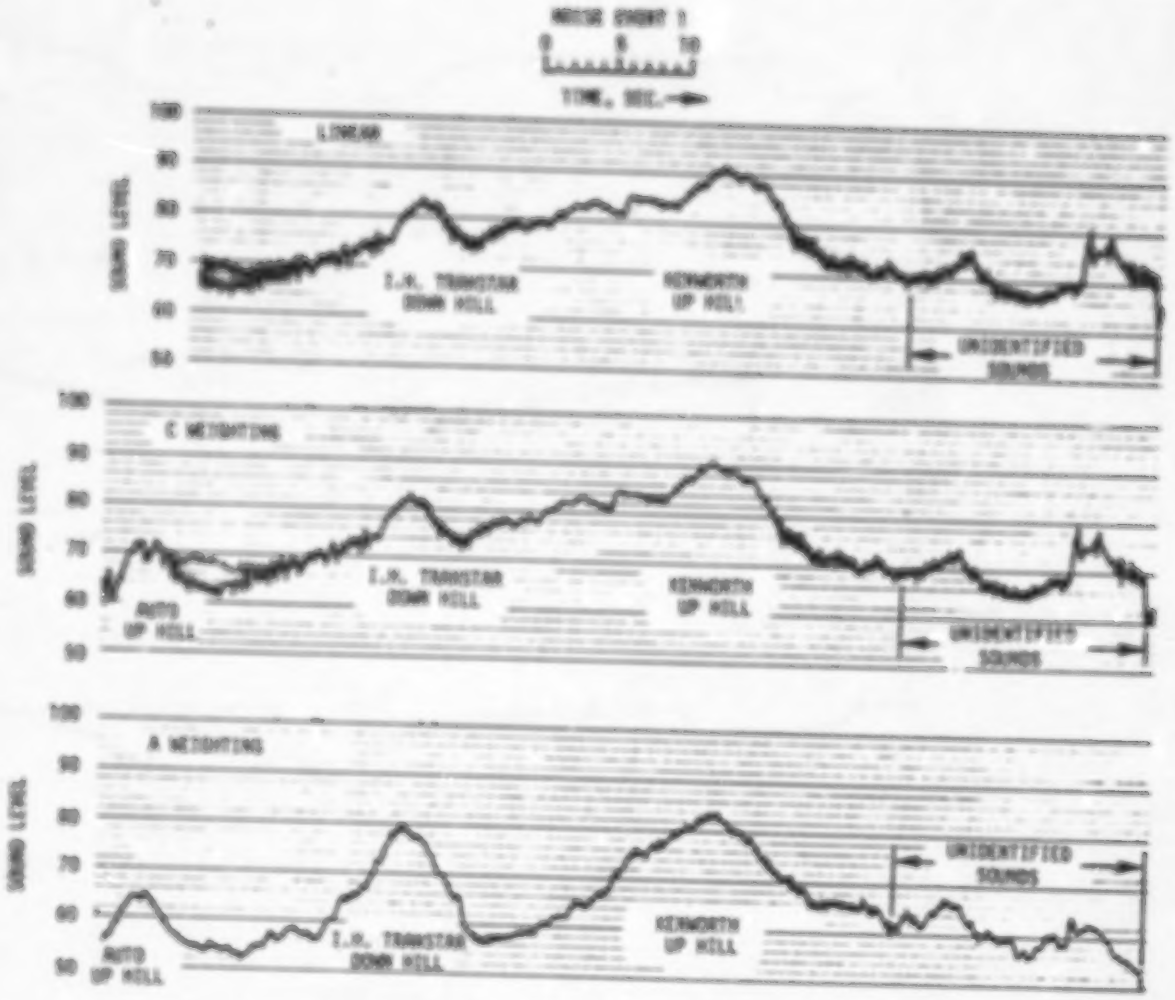
CALIBRATION SIGNAL


NOISE CHART 1
0
5
10
TIME, SEC.
LINEAR
SOUND LEVEL
100
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I.H. TRANSTAR
DOWN HILL
KENWORTH
UP HILL
UNIDENTIFIED
SOUNDS
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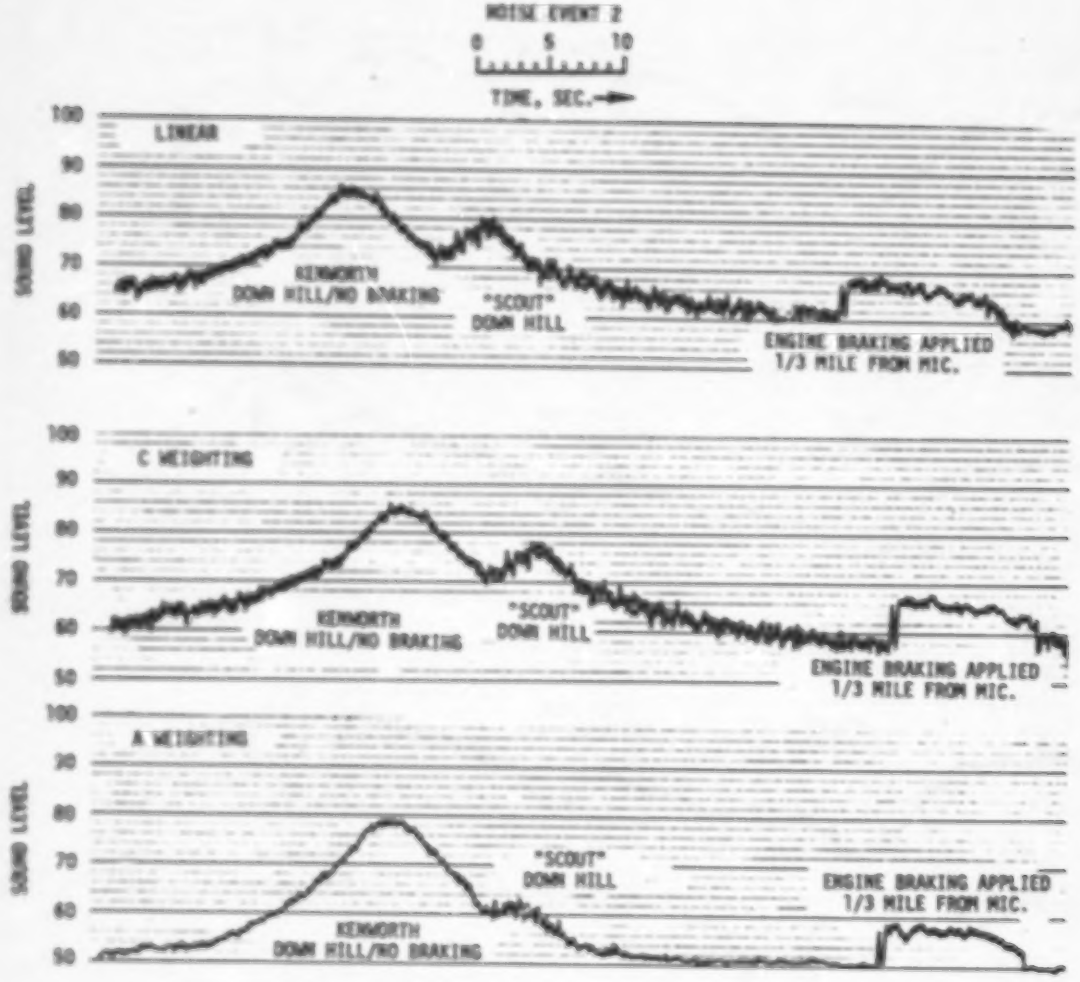
AUTO
UP HILL
A WEIGHTING


NOISE EVENT 2
0
5
10
TIME, SEC.
LINEAR
SOUND LEVEL
100
90
80
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50
KENWORTH
DOWN HILL/NO BRAKING
"SCOUT"
DOWN HILL
ENGINE BRAKING APPLIED
1/3 MILE FROM MIC.
C WEIGHTING
SOUND LEVEL
100
90
80
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60
50
KENWORTH
DOWN HILL/NO BRAKING
"SCOUT"
DOWN HILL
ENGINE BRAKING APPLIED
1/3 MILE FROM MIC.
A WEIGHTING
SOUND LEVEL
100
90
80
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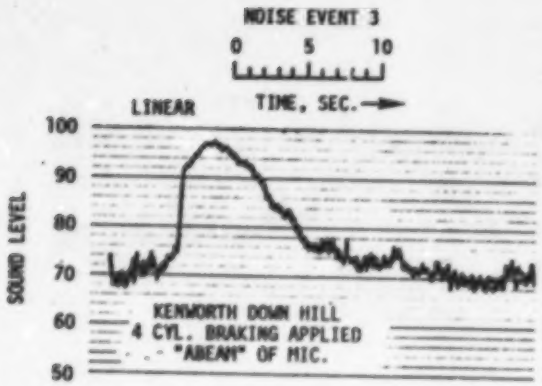
60
50
"SCOUT"
DOWN HILL
ENGINE BRAKING APPLIED
1/3 MILE FROM MIC.
KENWORTH
DOWN HILL/NO BRAKING


NOISE EVENT 3
0
5
10
LINEAR
TIME, SEC.
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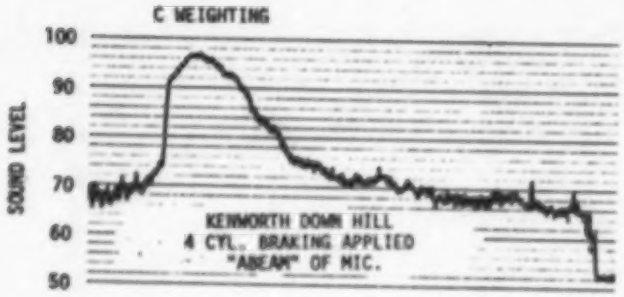
SOUND LEVEL
KENWORTH DOWN HILL
4 CYL. BRAKING APPLIED
"ABEAM" OF MIC.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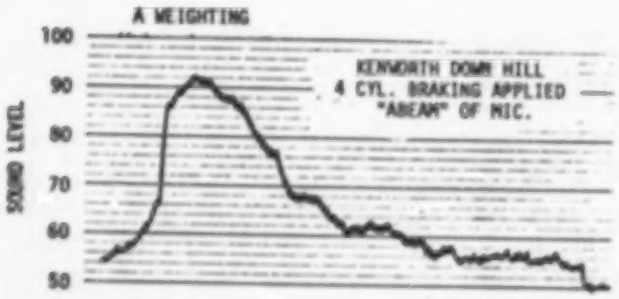
SOUND LEVEL
KENWORTH DOWN HILL
4 CYL. BRAKING APPLIED
"ABEAM" OF MIC.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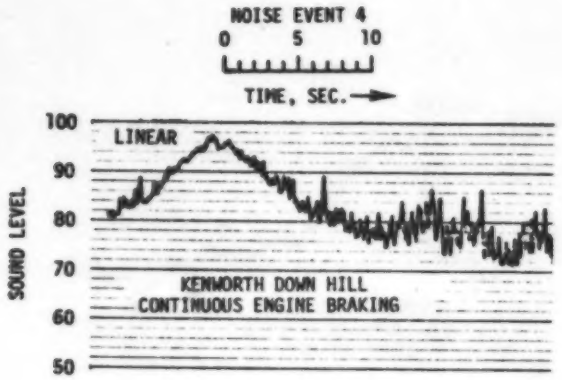
4 CYL. BRAKING APPLIED
"ABEAM" OF MIC.


NOISE EVENT 4
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TIME, SEC.
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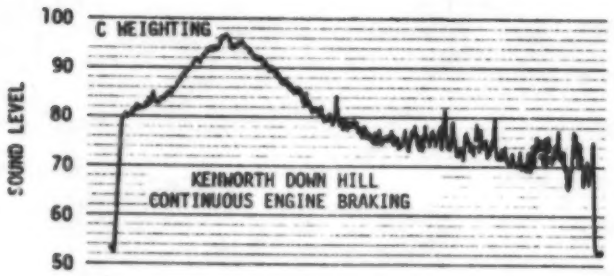
SOUND LEVEL
LINEAR
KENWORTH DOWN HILL
CONTINUOUS ENGINE BRAKING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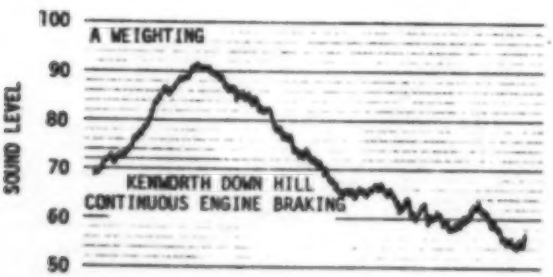
SOUND LEVEL
C WEIGHTING
KENWORTH DOWN HILL
CONTINUOUS ENGINE BRAKING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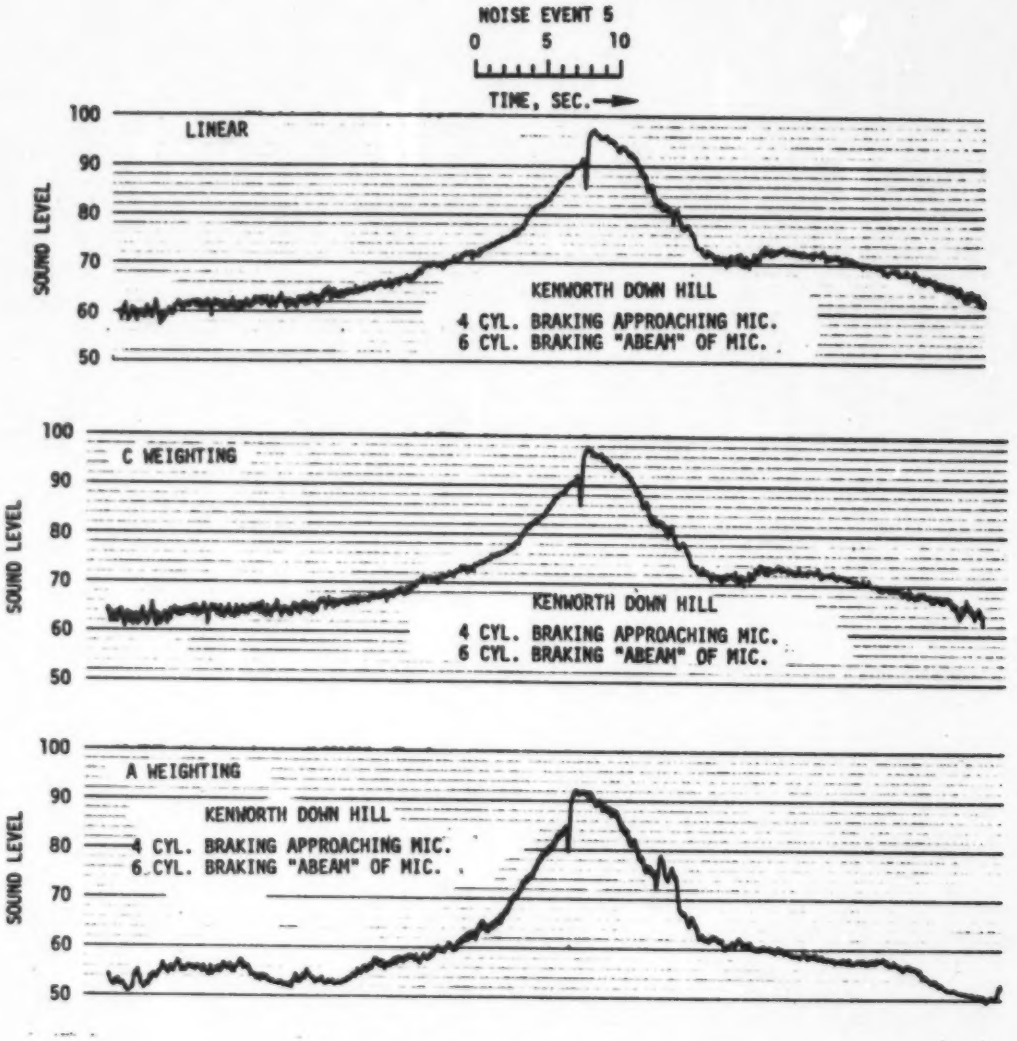
SOUND LEVEL
A WEIGHTING
KENWORTH DOWN HILL
CONTINUOUS ENGINE BRAKING


NOISE EVENT 5
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TIME, SEC.
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SOUND LEVEL
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KENWORTH DOWN HILL
4 CYL. BRAKING APPROACHING MIC.
6 CYL. BRAKING "ABEAM" OF MIC.
C WEIGHTING
SOUND LEVEL
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KENWORTH DOWN HILL
4 CYL. BRAKING APPROACHING MIC.
6 CYL. BRAKING "ABEAM" OF MIC.
A WEIGHTING
SOUND LEVEL
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KENWORTH DOWN HILL
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6 CYL. BRAKING "ABEAM" OF MIC.